# Deep Water Survey 2008

## Celtic Explorer
## 9TH – 22nd September 2008

Preliminary Report by

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## Abstract

The Marine Institute and the National University of Ireland, Galway conducted a deepwater survey in September 2008. This survey was the third in a series, carried out on the *RV Celtic Explorer,* gathering fishery and hydrographic data on the continental slope to the north and west of Ireland, and on the Porcupine Bank. The survey objectives were to collect biological data on the main deepwater fish species and invertebrates.

Fishing hauls were carried out at four depths, 500m, 1000m, 1500m, and 1800m, in each of three distinct Areas. Six comparative tows were carried out with Scottish Fisheries Science Service scientists aboard the *RV Scotia*. CTD data was collected along transects in each area. Cetacean observations were carried out by an observer from the Irish Whale and Dolphin Group.

The fisheries data collected will provide information for assessment of deepwater stocks, and will provide a time series for CPUE. 122 species of fish were identified, with a further 8 taken ashore for further work.

## Background and scientific objectives of survey

The Marine Institute fisheries science services ran a series of deepwater surveys along the northeastern shelf edge between 1992 and 1999. This survey programme was an important source of information on the distribution and abundance of deepwater fishes during the early development of the commercial fishery. Since then the fishery has drastically expanded and the deepwater commercial species as well as species taken as a bycatch have experienced severe fishing pressure, with many of the stocks being depleted or close to depletion. The survey was restarted in 2006, and the 2008 survey presents data from the same sites surveyed in the previous two years.

As in the previous two years the survey was again coordinated with the Scottish Fisheries Research Service. The *RV Scotia* fished comparative tows in Areas 2 and 4.

The specific objectives of the 2008 FSS deepwater survey are:

- To investigate the distribution and relative abundance of shelf edge, slope and deepwater fishes at three different sites in the north-east Atlantic.
- To collect biological information on the main deepwater species including length, weight, maturity, sex ratio and feeding.
- To coordinate the survey with the annual Scottish deepwater survey that is carried out in VIa and compare the data collected during comparative tows.
- To collect hydrographic data along four transects across the continental slope.
- To collect benthic invertebrate samples for the description of the benthic deepwater habitat.

- To collect ancillary data for ecosystem description including cetacean abundance and fishing activity.

# Materials and Methods

## Scientists

| | | |
|---|---|---|
| Brendan O' Hea | Marine Institute | Chief Scientist |
| Graham Johnston | Marine Institute | Wet Lab |
| Hans Gerritsen | Marine Institute | Deckmaster |
| Sarah Davie | Marine Institute | Wet Lab |
| Mairead Sullivan | Marine Institute | Wet Lab |
| Sean O' Connor | Marine Institute | Wet Lab |
| Michael McAuliff | Marine Institute | Wet Lab |
| Yvonne Leahy | Marine Institute | Benthic Ecologist |
| Christian Mohn | NUIG | Senior Scientist Oceanography |
| Anna Rengstorf | NUIG | Wet Lab / Oceanography |
| Kyle Sweeney | NUIG | Wet Lab |
| Dave Wall | IWDG | Cetacean Observer |
| Ana Maria Santos | UCC | Wet Lab |
| Hugh Boyle | MI Contractor | Gear Technician |

## Survey Area

The survey was carried out in the same three areas as 2006 and 2007, reflecting fishing areas covered during the Irish deepwater survey programme in the 1990s. Two areas were located on the western continental slope (FRS regions 2&4) and one area on the northern slope of the Porcupine Bank (FRS region 5). The overall sampling area, with fishing tows, is shown in figure 1. The survey was coordinated with the Scottish deepwater survey that covers the slope in area IVa from 55º to 58.5ºN and comparative tows were carried out in Areas 2 and 4.

## Sampling procedures

***Fish tows***

In each area trawl hauls were made at four depths, 500m, 1000m, 1500m and 1800 meters, along the slope, Table 1. The plan was to conduct two hauls at each depth in each area. Effective fishing time, when the net settled on the bottom, was set at two

hours. The tows were the same as last year. A new 1800m tow had to be scouted in both Areas 2 and 4, as we only had one tow at this depth last year. Similarly we had to find two new tows at 500m in Area 5. We had suffered gear damage on all tows at this depth in previous years. Hauls were carried out along the slope.

***Comparative Tows***

Comparative tows were carried out with the *RV Scotia* in Areas 2 and 4. For the first time both ships were in the same areas at the same time. In previous years the *Explorer* tended to fish sites a week ahead of the *Scotia*.

***CTD transects***

CTD transects were carried out in the same locations as last year, Table 3, Figure 1. Like last year it was occasionally necessary to collect the data over two nights. Plankton samples were collected at each station. A Bongo net was hauled vertically from 200m.

***Fish sampling***

At each station the entire catch was sorted to species level and weighed. Full biological sampling, length, weight, sex, maturity and age, was carried out on all commercial species. Additional biological sampling, without ageing, was carried out on all elasmobranchs and chimareids. For each species a random sample of the entire catch was taken for these measurements. Where fish were difficult to identify samples were preserved for further identification ashore. Samples of unusual or rare fish were also preserved.

Length measurements for various fish species were agreed on;

| | |
|---|---|
| Sharks | total length |
| Skates | total length |
| Chimaeras | pre supra caudal fin |
| Rhinochimaerids | second dorsal fin |
| Grenadiers | snout to base of anal fin |
| Bony fish | total length |
| Orange Roughy | total length |
| Black Scabbard | total length. |
| Smoothhead | standard length |

***Black Scabbard:***

As well as samples for our own programme Black Scabbard samples were collected for a Ph. D. student in UCC. Lengths, weights, otoliths, gonads and genetic samples were taken.

***Elasmobranchs:***
Tissue samples from several deepwater shark species were collected for studies at University College, Dublin, the University of Bangor, Wales, the Natural history Museum, Berlin and IPIMAR, Lisbon.

***Invertebrate sampling-***
All Invertebrates from each fishing tow were identified as far as possible, their catches weighed and entered into the database. Invertebrates chosen for the reference collection were preserved in 4% buffered formaldehyde.

***Cetacean studies***
A single marine mammal observer was present on board during the survey and conducted watches from the 'crow's nest' located above the bridge, 18m above sea level. Observer effort focused on a 90 degree arc ahead of the ship; however sightings located up to 90 degrees to port and starboard were also included. The observer scanned the area by eye and using 7 X 50 binoculars. Bearings to sightings were measured using an angle board and distances were estimated with the aid of distance measuring stick. Environmental data were recorded every 15 minutes using Logger 2000 software (IFAW 2000). Sightings were also recorded using Logger 2000. Automated position data were obtained through a laptop computer linked to a GPS Receiver Unit.

During the cetacean survey, a lookout was kept for any fishing vessels or fishing gear operating in the area. Vessel locations and fishing activity were noted where possible.

## Preliminary Results;

***Fish tows***
Twenty two out of twenty four planned tows were carried out, (Figure 1, Table 1). Problems were encountered on the 1800m tows when we started bursting large numbers of floats. During the survey we lost 95 floats, compared to 9 last year. One planned comparison tow in Area 4 was cancelled when it was noted that we had suffered gear damage there in the previous two years. The second 1800m tow in this Area was also cancelled due to the loss of floats. This would have been a new tow and we were therefore unsure of the ground. It was decided to carry out the shallower tows in Area 5 first, rather than put the survey in jeopardy by losing too many floats.

Gear damage was minimal and easily repaired. During tow 15 we came fast and snapped both starboard bridles. On tow 20 we broke the headline but spliced in a new piece before the next tow. No major tears to the net were reported.

Nineteen of the tows lasted the full haul time; three were cut short due to coming "fast". Area 2 produced the least problems with all hauls being completed successfully. We still have difficulties with clean 500m tows in Area 5. The seabed is

very rough and we suffer regular damage. To negate this we substituted 750m tows for the 500m.

At the end of tow 22 it was decided to conduct an exploratory tow to 2000m. This tow lasted 30 minutes and provided some new species not recorded on the previous surveys.

***Comparative tows***

In all, seven comparative tows were carried out, four in area 4 and three in area 2, (Table 2, figure 2). In Area 4 the *Scotia* and *Explorer* covered the same tows, in rotation, on the same day.

***CTD transects***

A total of 44 CTD stations were sampled and all the casts were successful, (Table 3, figure 1). At all stations up- and downcast profiles were taken at five transects along the Irish and Scottish continental margins over the whole water column, down to 10-30 m above the seafloor (depending on the observed bottom roughness and slope angle). This cruise provided the opportunity to repeat three of the five transects within 24 hours to study the effect of high frequency variability on water mass properties along the shelf edge.

In addition to the in-situ station sampling, the ship-mounted ADCP system was operated during the cruise to measure the three-dimensional flow field and to monitor the deep scattering layer for daily vertical zooplankton migration patterns.

Phytoplankton sampling at 20 selected stations was carried out using a 20 µm mesh net, 1 m long with an opening of 15 cm diameter and a collector volume of 200 ml. The net was hauled vertically from the surface down to 100 m depth and back at a speed of 0.5 m/s. The collected material was preserved in neutralized formalin (final concentration 0.6%)

***Fish sampling***

A total of 122 fish species were identified from an estimated catch of 55,325 individuals, approximately 24 tonnes. Of those 23,279 were measured. A further 8 species were brought back to the lab for further identification. The twenty most abundant species (by numbers) are given below:

| Species | | Catch No's |
|---|---|---|
| *Coryphaenoides rupestris* | Roundnose Grenadiers | 14833 |
| *Argentina silus* | Great Silver Smelt | 4217 |
| *Coelorhynchus coelorhynchus* | Hollownosed Rattail | 3942 |
| *Alepocephalus bairdii* | Baird's Smoothhead | 3757 |
| *Nezumia aequalis* | Smooth Rattail | 3389 |
| *Xenodermichthys copei* | Bluntsnout Smoothhead | 2686 |
| *Chimaera monstrosa* | Rabbitfish (Rattail) | 1804 |
| *Lepidion eques* | | 1734 |
| *Coryphaenoides guentheri* | Günther's Grenadier | 1515 |
| *Coelorhynchus labiatus* | Spearsnouted Grenadier | 1277 |

| | | |
|---|---|---|
| *Rouleina attrita* | Softskin Smoothhead | 1240 |
| *Trachyrhynchus murrayi* | Murray's Rattail | 1121 |
| *Helicolenus dactylopterus* | Blue-mouth Redfish | 1063 |
| *Synaphobranchus kaupi* | | 956 |
| *Halargyreus Johnsonii* | | 823 |
| *Aphanopus carbo* | Black Scabbard | 743 |
| *Micromesistius poutassou* | Blue Whiting | 668 |
| *Merluccius merluccius* | Europen Hake | 652 |
| *Galeus melastomus* | Blackmouthed Dogfish | 540 |
| *Chalinura mediterranea* | Mediterranean Grenadier | 458 |

Biological sampling (individual weight, sex, maturity and age) was carried out on a total of 1360 individuals of the target species given below:

| Code | Species | Samples |
|---|---|---|
| RNG | *Coryphaenoides rupestris* | 527 |
| BSF | *Aphanopus carbo* | 292 |
| HKE | *Merluccius merluccius* | 235 |
| BLI | *Molva dypterygia* | 100 |
| LIN | *Molva molva* | 55 |
| MON | *Lophius piscatorius* | 49 |
| RHF | *Hoplostethus atlanticus* | 40 |
| USK | *Brosme brosme* | 28 |
| PUS | *Centroscymnus coelolepis* | 27 |
| CSQ | *Centrophorus squamosus* | 7 |
| | Total | 1360 |

Additional biological sampling (weight, sex, maturity but no age) was carried out on an ad-hoc basis on 1474 individuals of the following species:

| Code | Species | Samples |
|---|---|---|
| RBF | *Chimaera monstrosa* | 314 |
| NNC | *Harriotta raleighana* | 160 |
| ESP | *Etmopterus princeps* | 125 |
| RTF | *Hydrolagus mirabilis* | 124 |
| CMS | *Centroscymnus crepidater* | 115 |
| DBM | *Galeus melastomus* | 111 |
| HAF | *Hydrolagus affinis* | 107 |
| DAC | *Deania calcea* | 95 |
| APH | *Apristurus aphyodes* | 82 |
| VBY | *Etmopterus spinax* | 64 |
| DAL | *Apristurus laurussoni* | 38 |
| CSF | *Centroscyllium fabricii* | 28 |
| AMA | *Apristurus manis* | 25 |
| RHA | *Rhinochimaera atlantica* | 21 |
| AME | *Apristurus melanoasper* | 14 |
| DGM | *Galeus murinus* | 13 |

| | | |
|---|---|---|
| RDS | *Rajella (raja) fyllae* | 8 |
| SGS | *Hexanchus griseus* | 7 |
| SKT | *Dipturus (raja) batis* | 4 |
| AJE | *Amblyraja jenseni* | 3 |
| BRI | *Bathyraja richardsoni* | 3 |
| HPS | *Hydrolagus pallidus* | 3 |
| BRP | *Bathyraja (breviraja) pallida* | 3 |
| RBA | *Raja bathyphilia* | 2 |
| SAR | *Leucoraja circularis* | 2 |
| BCA | *Breviraja caerulea* | 1 |
| SDR | *Raja montagui* | 1 |
| RBI | *Rajella bigelowi* | 1 |
| | Total | 1474 |

***Invertebrate sampling-***

A total of 94 invertebrate species were identified in the 23 trawls, (table 4). Preliminary identifications were carried out on board using keys generated on the previous two deepwater surveys, and various reference books. Detailed descriptions were recorded for each taxa sampled. In addition samples were photographed and some samples were retained for future reference.

The species caught on the survey were similar to those caught on the 2006 and 2007 surveys, with more or less the same echinoderm, crustacean and mollusc species being recorded. *Todarodes saggittatus,* Northern flying squid, was the most abundant species recorded, being found at 17 of the 23 stations. The next most common species was *Phorosoma placenta*, a stalked tunicate, being recorded at 15 stations. Station 8 produced the greatest number of species at 26, closely followed by station 7 with 24, and station 2 with 21.

***Cetacean Survey Results***

61.9 hours of survey time were logged with 41.2% (25.5hrs) of this at ≤ Beaufort sea state three. Seventy seven sightings of at least eight cetacean species, totalling 757 individuals were recorded, (Appendix 2).

Identified dolphin species were Common dolphin (*Delphinus delphis*), Bottlenose dolphin (*Tursiops truncatus*), Pilot whale (*Globicephala melas*) and Striped dolphin (*Stenella coeruleoalba*). Two sightings of unidentified breaching beaked whale species were also made. Identifies whale species were Blue whale (*Balaenoptera musculus*), Sperm whale (*Physeter macrocephalus*) and Fin whale (*Balaenoptera physalus*).

Pilot whales were the most commonly encountered species along the continental shelf slopes, while common dolphins were only encountered over shallower waters on the continental shelf. The distribution of beaked whale sightings appears to correlate well with the presence of deep water canyons along the shelf slopes

10 bird species were recorded during the survey: lesser black backed gull (*Larus fuscus*), great black backed gull (*Larus marinus*), great skua (*Stercorarius skua*), parasitic skua (Stercorarius parasiticus), gannet (*Morus bassanus*), fulmar (*Fulmarus glacialis*), Manx shearwater (*Puffinus puffinus*), sooty shearwater (*Puffinus griseus*), kittiwake (*Rissa tridactyla*) and storm petrel (*Hydrobates pelagicus*). A number of waders were also noted on or around the vessel.

**Table 1.** Table of trawl positions

| Haul | Date | Shot Lat | Shot Lon | Haul Lat | Haul Lon | Depth | Area |
|---|---|---|---|---|---|---|---|
| 1 | 11/09/2008 | 56° 43.790 | 009° 02.035 | 56° 38.147 | 009° 03.061 | 493 | 2 |
| 2 | 11/09/2008 | 56° 45.233 | 009° 09.811 | 56° 39.743 | 009° 12.079 | 1038 | 2 |
| 3 | 11/09/2008 | 56° 48.084 | 009° 20.873 | 56° 53.625 | 009° 20.472 | 1481 | 2 |
| 4 | 12/09/2008 | 56° 48.111 | 009° 42.112 | 56° 43.355 | 009° 48.714 | 1840 | 2 |
| 5 | 12/09/2008 | 56° 52.093 | 009° 20.575 | 56° 46.045 | 009° 21.110 | 1495 | 2 |
| 6 | 12/09/2008 | 56° 47.575 | 009° 03.767 | 56° 40.952 | 009° 01.368 | 511 | 2 |
| 7 | 13/09/2008 | 56° 54.389 | 009° 34.591 | 56° 49.263 | 009° 40.808 | 1786 | 2 |
| 8 | 13/09/2008 | 56° 41.396 | 009° 11.043 | 56° 35.457 | 009° 15.057 | 982 | 2 |
| 9 | 14/09/2008 | 55° 22.535 | 010° 03.791 | 55° 16.570 | 010° 07.774 | 987 | 4 |
| 10 | 14/09/2008 | 54° 57.500 | 010° 30.458 | 54° 52.705 | 010° 37.425 | 1512 | 4 |
| 11 | 15/09/2008 | 55° 22.294 | 009° 57.448 | 55° 15.665 | 010° 01.779 | 539 | 4 |
| 12 | 15/09/2008 | 55° 12.516 | 010° 09.348 | 55° 07.971 | 010° 09.944 | 1037 | 4 |
| 13 | 15/09/2008 | 55° 09.774 | 010° 04.694 | 55° 16.134 | 010° 01.634 | 515 | 4 |
| 14 | 16/09/2008 | 55° 02.109 | 010° 25.981 | 55° 01.232 | 010° 28.202 | 1891 | 4 |
| 15 | 17/09/2008 | 53° 53.649 | 013° 16.925 | 53° 53.125 | 013° 20.306 | 403 | 5 |
| 16 | 17/09/2008 | 53° 53.664 | 013° 43.658 | 53° 50.803 | 013° 53.600 | 1004 | 5 |
| 17 | 17/09/2008 | 53° 56.736 | 013° 55.127 | 53° 58.544 | 013° 46.677 | 1482 | 5 |
| 18 | 18/09/2008 | 54° 07.851 | 012° 48.859 | 54° 07.570 | 012° 57.611 | 1503 | 5 |
| 19 | 18/09/2008 | 54° 02.236 | 012° 51.570 | 54° 02.215 | 013° 02.575 | 1012 | 5 |
| 20 | 19/09/2008 | 53° 58.860 | 012° 43.360 | 53° 59.121 | 012° 49.511 | 746 | 5 |
| 21 | 19/09/2008 | 53° 59.794 | 013° 59.912 | 53° 57.636 | 014° 07.125 | 1827 | 5 |
| 22 | 20/09/2008 | 54° 01.748 | 013° 49.540 | 54° 02.091 | 013° 41.577 | 1818 | 5 |
| 23 | 20/09/2008 | 54° 02.040 | 013° 57.416 | 54° 01.602 | 013° 59.541 | 2000 | 5 |

**Table 2.** Table of comparative trawl positions

| Haul | Date | Shot Lat | Shot Lon | Haul Lat | Haul Lon | Depth | Area | |
|---|---|---|---|---|---|---|---|---|
| 2 | 11/09/2008 | 56.7539 | 9.1635 | 56.6624 | 9.2013 | 1038 | 2 | Irish |
| 4 | 12/09/2008 | 56.8019 | 9.7019 | 56.7226 | 9.8119 | 1840 | 2 | Irish |
| 5 | 12/09/2008 | 56.8682 | 9.3429 | 56.7674 | 9.3518 | 1495 | 2 | Irish |
| 6 | 12/09/2008 | 56.7929 | 9.0628 | 56.6825 | 9.0228 | 511 | 2 | Irish |
| 10 | 14/09/2008 | 54.9583 | 10.5076 | 54.8784 | 10.6238 | 1512 | 4 | Irish |
| 12 | 15/09/2008 | 55.2086 | 10.1558 | 55.1329 | 10.1657 | 1037 | 4 | Irish |
| 13 | 15/09/2008 | 55.1629 | 10.0782 | 55.2689 | 10.0272 | 515 | 4 | Irish |
| | | | | | | | | |
| 388 | 15/09/2008 | 56.7360 | 9.1748 | 56.8415 | 9.1690 | 1000 | 2 | Scottish |
| 386 | 15/09/2008 | 56.7298 | 9.8015 | 56.8190 | 9.6805 | 1800 | 2 | Scottish |
| 387 | 15/09/2008 | 56.8500 | 9.3390 | 56.7477 | 9.3737 | 1500 | 2 | Scottish |
| 389 | 16/09/2008 | 56.6935 | 9.0242 | 56.8235 | 9.0647 | 500 | 2 | Scottish |
| 383 | 14/09/2008 | 54.9433 | 10.5470 | 54.9657 | 10.4702 | 1500 | 4 | Scottish |
| 385 | 14/09/2008 | 55.2298 | 10.1478 | 55.1415 | 10.1777 | 1000 | 4 | Scottish |
| 384 | 14/09/2008 | 55.1363 | 10.0822 | 55.2462 | 10.0370 | 500 | 4 | Scottish |

**Table 3.** CTD positions and depths

| Cast | No. | Date | Depth (m) | Lat | Lon | Area |
|---|---|---|---|---|---|---|
| 1 | A2-750 | 11/09/2008 | 750 | 56° 39.96 | 009° 06.12 | 2 |
| 2 | A2-1000 | 11/09/2008 | 1000 | 56° 39.06 | 009° 13.05 | 2 |
| 3 | A2-1250 | 11/09/2008 | 1250 | 56° 40.20 | 009° 20.10 | 2 |
| 4 | A2-1500 | 11/09/2008 | 1500 | 56° 41.70 | 009° 32.16 | 2 |
| 5 | A2-200 | 12/09/2008 | 200 | 56° 39.30 | 008° 59.98 | 2 |
| 6 | A2-450 | 12/09/2008 | 450 | 56° 39.54 | 009° 01.26 | 2 |
| 7 | A2-750 | 12/09/2008 | 750 | 56° 39.96 | 009° 06.12 | 2 |
| 8 | A2-1000 | 12/09/2008 | 1000 | 56° 39.06 | 009° 13.05 | 2 |
| 9 | A2-1250 | 12/09/2008 | 1250 | 56° 40.20 | 009° 20.10 | 2 |
| 10 | A2-1500 | 12/09/2008 | 1500 | 56° 41.70 | 009° 32.16 | 2 |
| 11 | A4-2000 | 14/09/2008 | 2000 | 55° 19.50 | 010° 21.70 | 4 |
| 12 | A4-1500 | 14/09/2008 | 1500 | 55° 17.40 | 010° 15.54 | 4 |
| 13 | A4-1000 | 14/09/2008 | 1000 | 55° 15.00 | 010° 08.16 | 4 |
| 14 | A4-750 | 14/09/2008 | 750 | 55° 14.10 | 010° 05.40 | 4 |
| 15 | A4-450 | 14/09/2008 | 450 | 55° 13.32 | 010° 02.40 | 4 |
| 16 | A4-250 | 15/09/2008 | 250 | 55° 11.90 | 009° 56.80 | 4 |
| 17 | A4-450 | 15/09/2008 | 450 | 55° 13.32 | 010° 02.40 | 4 |
| 18 | A4-750 | 15/09/2008 | 750 | 55° 14.10 | 010° 05.40 | 4 |
| 19 | A4-1000 | 15/09/2008 | 1000 | 55° 15.00 | 010° 08.16 | 4 |
| 20 | A4-1500 | 15/09/2008 | 1500 | 55° 17.40 | 010° 15.54 | 4 |
| 21 | A4-2000 | 15/09/2008 | 2000 | 55° 19.50 | 010° 21.70 | 4 |
| 22 | A5C-2000 | 17/09/2008 | 2000 | 54° 07.40 | 013° 14.50 | 5 |
| 23 | A5C-1750 | 17/09/2008 | 1750 | 54° 06.30 | 013° 14.50 | 5 |
| 24 | A5C-1500 | 17/09/2008 | 1500 | 54° 05.10 | 013° 14.40 | 5 |
| 25 | A5C-1250 | 17/09/2008 | 1250 | 54° 02.90 | 013° 14.20 | 5 |
| 26 | A5C-1000 | 17/09/2008 | 1000 | 54° 00.50 | 013° 13.90 | 5 |
| 27 | A5C-750 | 17/09/2008 | 750 | 53° 58.40 | 013° 13.60 | 5 |
| 28 | A5C-500 | 17/09/2008 | 500 | 53° 55.90 | 013° 13.10 | 5 |
| 29 | A5E-500 | 17/09/2008 | 500 | 53° 57.06 | 012° 50.76 | 5 |
| 30 | A5E-750 | 17/09/2008 | 750 | 53° 59.40 | 012° 49.02 | 5 |
| 31 | A5E-1000 | 17/09/2008 | 1000 | 54° 01.92 | 012° 46.92 | 5 |
| 32 | A5E-1250 | 17/09/2008 | 1250 | 54° 04.50 | 012° 44.80 | 5 |
| 33 | A5E-1500 | 17/09/2008 | 1500 | 54° 08.04 | 012° 42.48 | 5 |
| 34 | A5W-1250 | 18/09/2008 | 1250 | 53° 53.16 | 013° 57.90 | 5 |
| 35 | A5W-1000 | 18/09/2008 | 1000 | 53° 50.70 | 013° 54.30 | 5 |
| 36 | A5W-750 | 18/09/2008 | 750 | 53° 48.24 | 013° 49.98 | 5 |
| 37 | A5W-500 | 18/09/2008 | 500 | 53° 47.34 | 013° 44.58 | 5 |
| 38 | A5W-350 | 18/09/2008 | 350 | 53° 45.48 | 013° 37.26 | 5 |
| 39 | A5W-1500 | 19/09/2008 | 1500 | 53° 55.67 | 014° 01.49 | 5 |
| 40 | A5W-1250 | 19/09/2008 | 1250 | 53° 53.16 | 013° 57.90 | 5 |
| 41 | A5W-1000 | 19/09/2008 | 1000 | 53° 50.70 | 013° 54.30 | 5 |
| 42 | A5W-750 | 19/09/2008 | 750 | 53° 48.24 | 013° 49.98 | 5 |
| 43 | A5W-500 | 19/09/2008 | 500 | 53° 47.34 | 013° 44.58 | 5 |
| 44 | A5W-350 | 19/09/2008 | 350 | 53° 45.48 | 013° 37.26 | 5 |

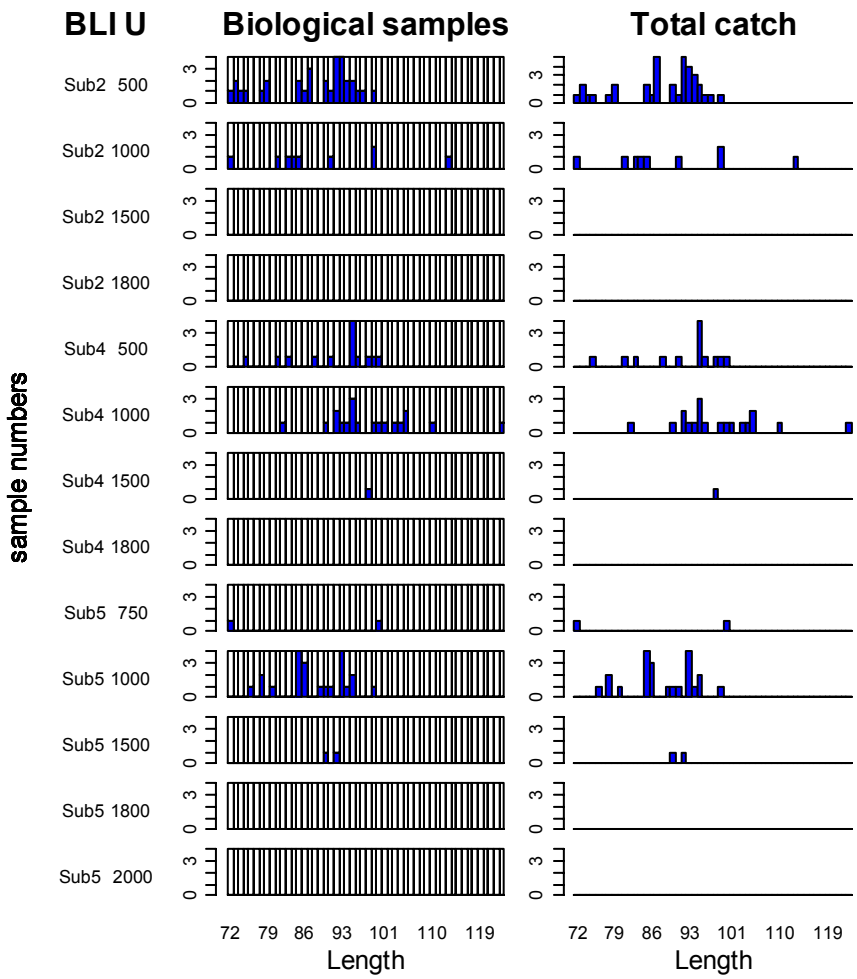
**Table 4.** Stations showing presence of invertebrates

| Stations | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Acanthephyra purpurea* | | X | X | X | X | | X | X | | | | X | | X | X | | | X | | | X | X | 12 |
| *Acteon tornatilis* | | | | | | | | | | | | | | | | X | | | | | | | 1 |
| *Actinauge richardii* | | X | | | | | | X | | | | X | X | | X | | | X | | | | X | 7 |
| *Adamsia carciniopados* | X | | | | | | | | | | | | | | | | | | | | | | 1 |
| *Amphipoda* | | | X | | | | X | | | | | | | | | | | | | | | | 2 |
| *Anapagurus in epizoanthus* | | | | | | X | | X | | | | | X | | | | X | X | X | X | X | X | 9 |
| *Anthozoan sp* | | | X | | X | | | X | | | X | | | | | X | | X | | X | | | 7 |
| *Araeosoma fenestratum* | | | | | | | | | | | | | | | | | | | X | | | | 1 |
| *Araeosoma hystrix* | | | | | | | | | | | | X | | X | | | | | | | | | 2 |
| *Asteropectinidae* | | | | | | | X | | | | | | | | | | | | | | | | 1 |
| *Benthogone rosea* | | | | | | | | | | | | | | | | X | X | | | X | X | X | 5 |
| *Bentoctopus* | | X | X | | | | | | | | | | X | | | X | | X | | | | | 5 |
| *Benthodytes sp* | | | | X | | | X | | | | | | | X | | | | | | | | | 3 |
| *Benthodytes typica* | | | | | | | | | | | | | | X | | | | | | | | | 1 |
| *Benthopectinidae* | | | | | | | X | | | | | | | | | | | | | | | | 1 |
| *Brisingella coronata* | | | | X | | | X | | | | | | | | | | | | | | | | 2 |
| *Buccinium undulatum* | | X | | | | | | | | | | | | | | | | | | | | | 1 |
| *Cancer bellianus* | | | | | | | | | | | X | | | | | | | | | | | | 1 |
| *Cancer pagurus* | X | X | | | | | | | | | | | | | | | | | | | | | 2 |
| *Caridae* | | | | | | | | X | | | | | | | | | | | | | | | 1 |
| *Chaceon affinis* | | | | | | | | | | | | | X | | | | | | | | | | 1 |
| *Cidaris cidaris* | X | X | | | | X | X | | | | X | X | X | X | X | | | | X | X | | | 11 |
| *Cirrina sp* | | | | | | | | | | | | | | X | | | | | | | | X | 2 |
| *Cirrina sp 2* | | | | | | | | | | | | | | | | | | | | | | X | 1 |
| *Colossendeis colossea* | | | | | | | | | | | | | | | X | | | X | | | | | 2 |
| Copepod parasite | | | | | | | | | | | | | | | | | | | | | X | | 1 |

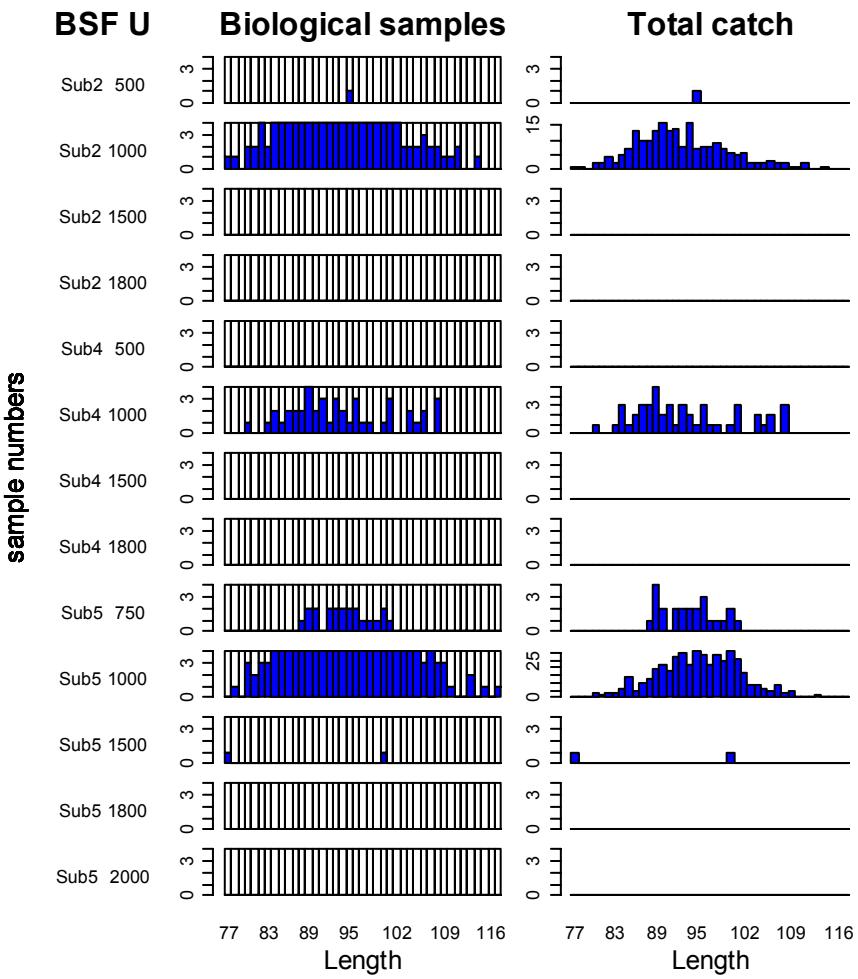
| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coral | | | | | | | | | | | X | | | | | | | | | | | | | 1 |
| *Crangon sp* | | | | | X | | | X | | | | | | | X | | | | | | | | | 3 |
| *Crinoidae* | | | X | | | | | | | | | | | | | | | | | | | | | 1 |
| *Diploteraster multipes* | | | | | | | | | | | | | | | | | | X | | | | | | 1 |
| *Echinus acutus* | X | X | | X | | X | | X | | | | X | | X | | | | | | | | | | 7 |
| *Echinus elegans* | | | | | | | X | X | | | | X | | | | | | X | | | | X | X | 6 |
| *Eryonoidae* | | | X | X | X | | | | | | | | | | | | | | | | | | | 3 |
| *Freyella elegans* | | | | | | | X | | | | | | | | | | | | | | | | X | 2 |
| *Geryon sp* | | | | | | | | | | | | | X | | | | | | | | | X | | 2 |
| *Gnathopausia zoea* | | X | X | X | X | | X | X | | X | | | | X | X | | X | | | | X | X | | 12 |
| *Holothuridae* | | | | | X | | | | | | | | | | | | | | | | | | | 1 |
| *Hygrosoma petersii* | | X | X | X | X | | | | | | | X | | | | X | X | X | X | X | X | X | | 12 |
| Isopod sp 1 | | | | | | | | | | | X | | | | | | | | | | | | | 1 |
| Isopod sp 2 | | | | | | | | | | | | | | | | | | | | | | | X | 1 |
| *Laetmogone violacea* | | X | | | | | | X | | | | | | | | | | X | | | | | | 3 |
| *Majidae* | X | | | | X | X | | | | | | | | | | X | | | | | | | | 4 |
| *Monodaeus couchi* | | | | | | | | | | | X | | | | | | | | | | | | | 1 |
| *Munida intermedia* | | | | | | | | X | | | | | | | | | | | | | | | | 1 |
| *Munida rugosa* | | X | | | | | | | | | | | | | | | | | | | | | | 1 |
| *Munidopsis curvirostra* | | | | X | | | | | | | | | | | | | | | | | | | | 1 |
| *Neolithodes grimaldi* | | | X | | | | | | | X | | | | | | X | X | | | | X | | | 5 |
| *Nephropidae* | | X | X | X | | X | X | X | | X | | | | X | X | X | X | | | | X | X | X | 14 |
| *Nudibranch sp* | | | | | | | | | | | | | | | | | | | | | | X | | 1 |
| *Ophiocomidae* | | | | | | | | X | | | | X | | | | | | | | | | | | 2 |
| *Ophiomusium lymani* | | | | | | | X | X | | | | | | | | | | | | | | | | 2 |
| *Opisthoteuthis massaye* | | X | | | | | | X | | | | X | | X | | | | X | | | X | X | | 7 |
| *Ophiuridae* | X | | | | | | | | | | | | | | | | | | | | | | | 1 |
| *Pagurus prideaux* | X | | | | | | | | | | | | | | | | | | | | | | | 1 |
| *Palaemonidae* | X | | | | | X | | | | | | | | | | | | | | | | | | 2 |
| *Palinuroidae* | | | | | | | | | | | | X | | | | | | | | | | | | 1 |
| *Pandaloidae* | | | | | | | | | | | X | | | | | | | | | | | | | 1 |

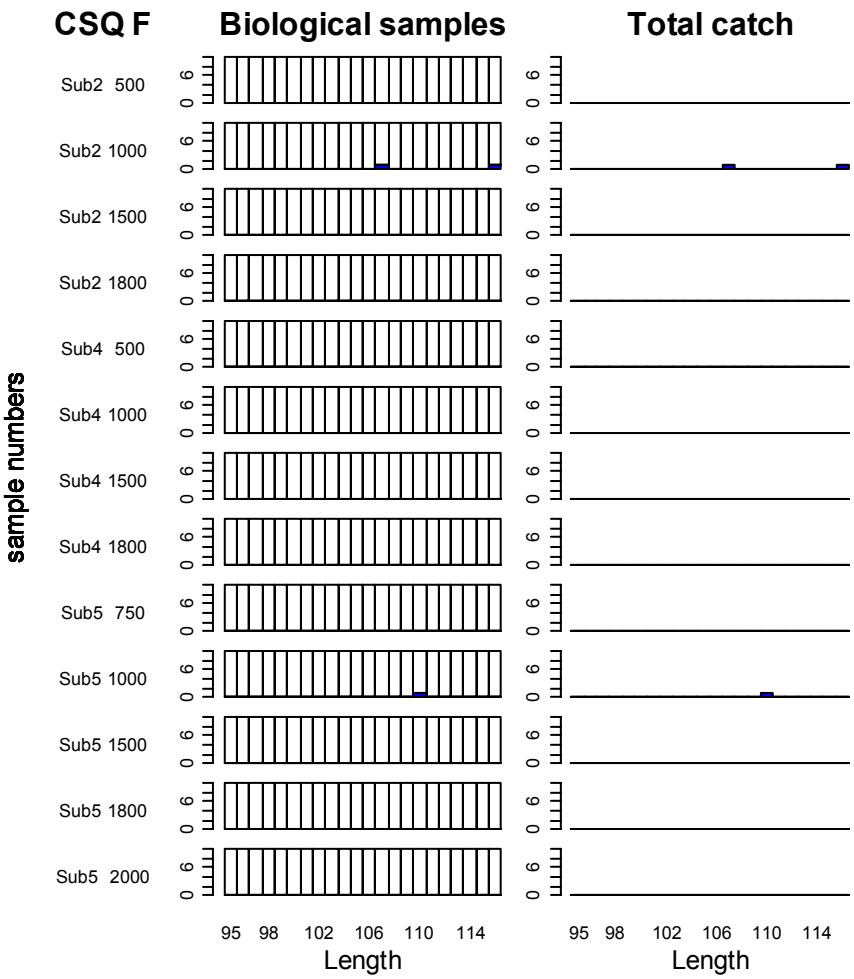
| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Parapasiphaea sulcatifrons* | | | | | | | | | | | | X | | | | | | | | | | | 1 |
| *Parastichtropus tremulus* | X | X | X | | | X | X | X | | | X | X | X | | | | | | | | | | 9 |
| *Pasiphaea multidentata* | | | | | | | | X | | | | | | | | | X | X | X | | | | 4 |
| *Pasiphaea tarda* | | | | | | | X | X | | X | | X | | X | X | | | | | X | X | | 8 |
| *Pasiphaea spp* | | X | | | | X | | | | | | | | | | | | | | | | | 2 |
| *Phorosoma placenta* | | X | X | X | | | X | X | | | | X | X | X | X | X | X | X | | X | X | X | 15 |
| *Plinthaster perrieri* | | | | | | X | | | | | | | | | | | | | | | | | 1 |
| *Plutonaster bifrons* | | | | X | | X | | X | | X | X | | | X | X | X | X | X | | X | | X | 12 |
| *Polynoidae* | | | | | | | | | | X | | | | | | | | | X | | | | 2 |
| *Polycheles nanus* | | | | | | | X | X | | | | | | X | | X | | | | X | X | X | 7 |
| *Polycheles typhlops* | | | | | | X | | | | | X | | X | | | | | | X | | | | 4 |
| *Polycheles sp* | | | | | | | | | | X | | | | | | | | | | | | | 1 |
| *Porania pulvillus* | X | X | | | | X | X | | | | X | | X | | | | | | | | | | 6 |
| *Poraniomorpha borealis* | | | | | | X | | | | | | | | | | | | | | | | | 1 |
| *Porifera* | X | | | | | | X | | | | | | | | | | | | | | | | 2 |
| *Portunidae* | | X | | | | | | | | | | | | | | | | | | | | | 1 |
| *Pseudamussium septemradiatu* | X | X | | | | X | X | | | | | | | | | | | | | | | | 4 |
| *Psilaster andromeda* | | | | | | | | X | | | | | | | | | | X | | | | | 2 |
| *Pterasteridae* | | | | | | | | | | | | | | | | | X | | | | | | 1 |
| *Radiaster tizardi* | | | | | | | | | | | | | | | X | X | | | | | | | 2 |
| Sea pen sp A1 | | | | | | | | | | | X | | | | X | | | | | | | | 2 |
| Sea pen sp A2 | | | | | | | | | | | | | | | | | | X | X | | | | 2 |
| Sea pen sp A3 | | | | | | | | | | | | | | | | | | | X | | | | 1 |
| *Sepiolidae* | | | | X | | | | | | | | | | | | | | | | | | | 1 |
| *Sergia robusta* | | X | | | X | | | X | | | | X | | X | X | | | X | | | | | 7 |
| Soft coral | | | | | | | X | | | | | | | | | | | | | | | | 1 |
| *Spinulosidae* | | | | | | X | X | | | | X | | | | | | | | | | | | 3 |
| Sponge | | | | | | | X | X | | | | | | | | | | | | | | | 2 |
| Sponge sp 2 | | | | | | | | | | | | | | | | | | | | X | | | 1 |
| Sponge sp 3 | | | | | | | | | | | | | | | | | | | | | X | X | 2 |
| Sponge sp 4 | | | | | | | | | | | | | | | | | | | | | X | X | 2 |

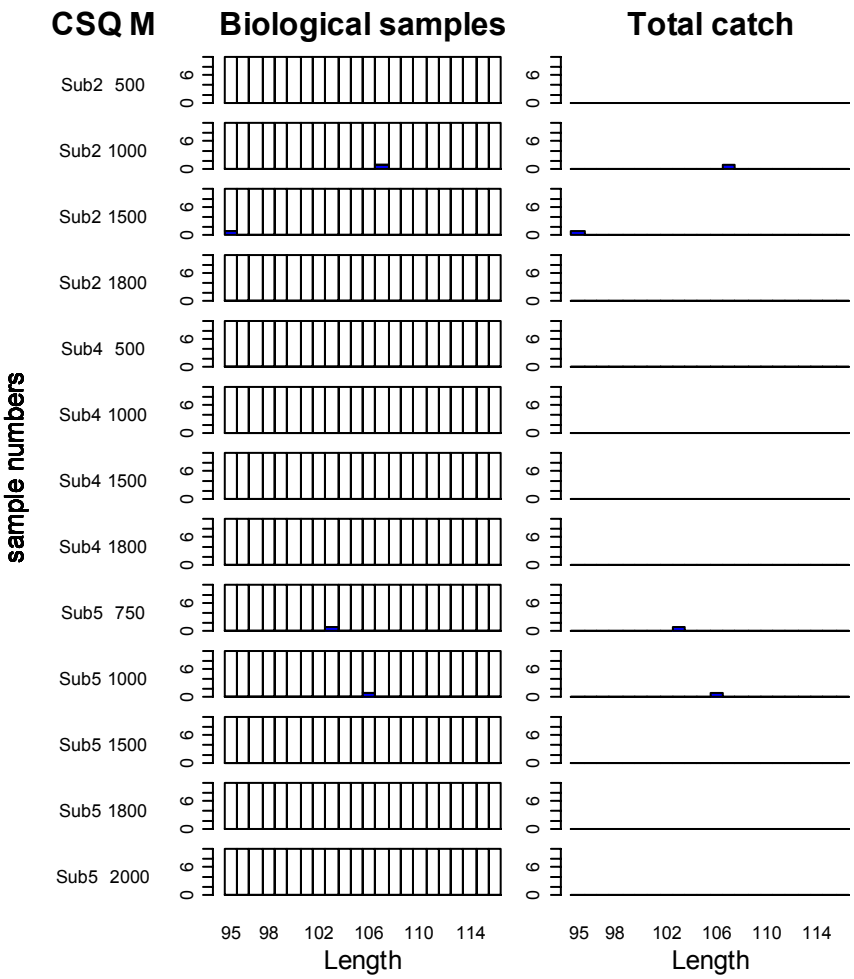
| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sponge sp 5 | | | | | | | | | | | | | | | | | | | | | | | X | 1 |
| *Stauroteuthis syrtensis* | | | | X | | X | | | | X | X | | | X | | | X | | | X | | | | 7 |
| *Todarodes saggittatus* | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | | X | X | | | | | X | 17 |
| *Valvatidae* | | | | | | X | X | | | | | | | | | | | | | | | | | 2 |
| *Zoroaster fulgens* | | | | X | | X | | X | | | X | | | | | X | X | | X | | | | | 7 |
| *Zoroasteridae* | | | X | | X | | | | | | | | | | | | | | | | | | | 2 |
| **Total** | 13 | 21 | 14 | 15 | 11 | 19 | 24 | 26 | 1 | 8 | 16 | 15 | 11 | 16 | 14 | 13 | 13 | 18 | 10 | 15 | 16 | 18 | | |

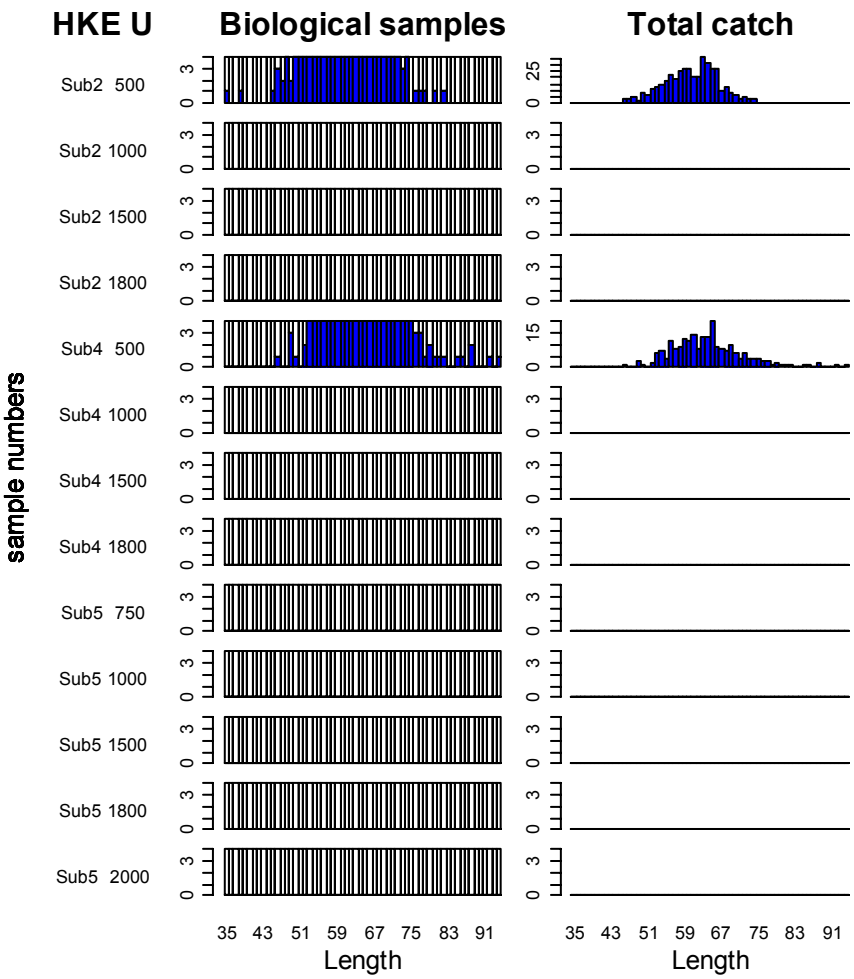


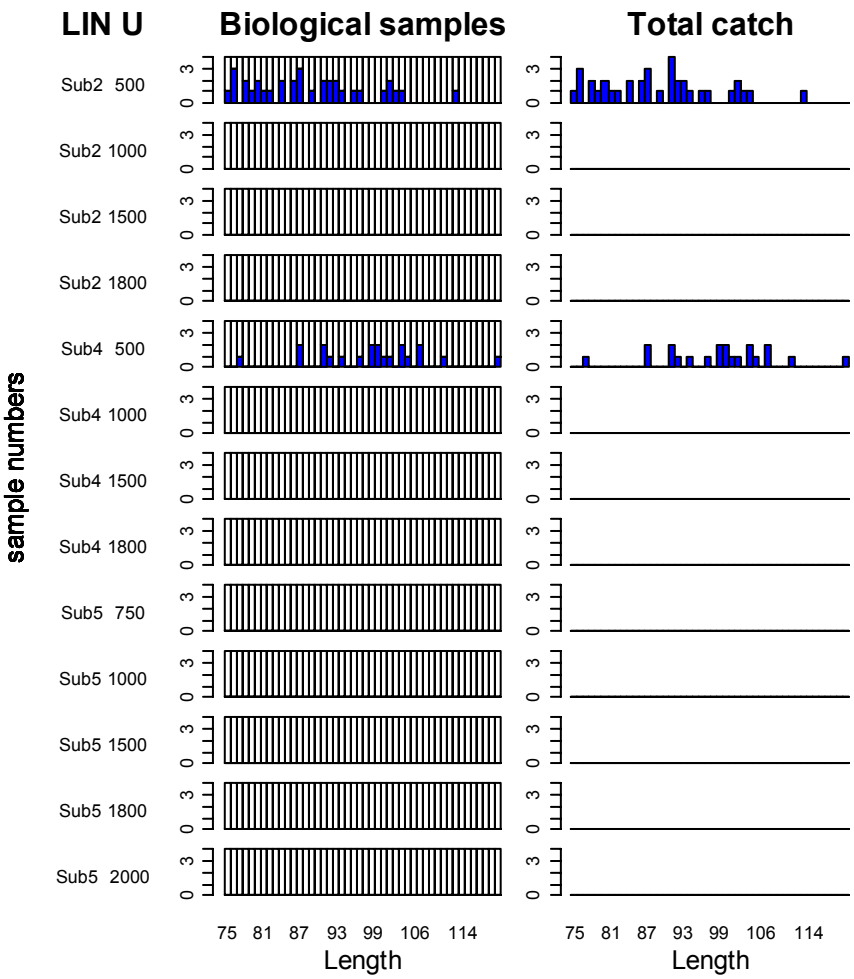

These figures show the length distribution of the biological samples (left) and catch (right) for the target species by depth and area:

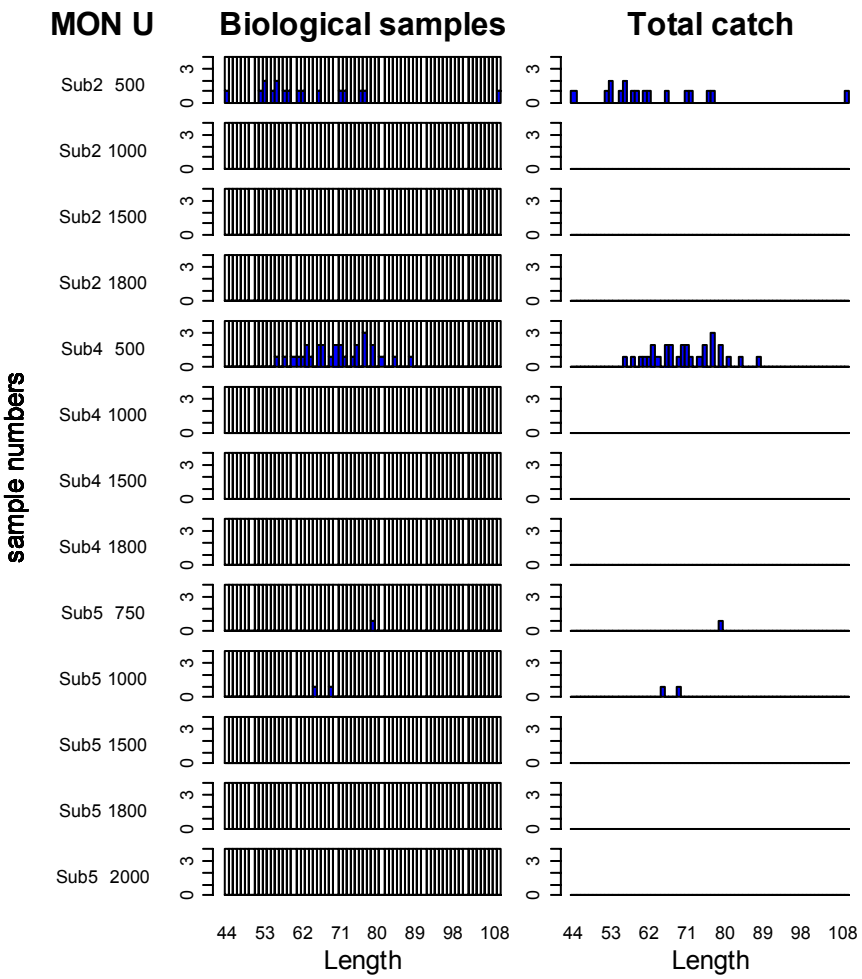

BSF U
Biological samples
Total catch
sample numbers
Sub2 500
Sub2 1000
Sub2 1500
Sub2 1800
Sub4 500
Sub4 1000
Sub4 1500
Sub4 1800
Sub5 750
Sub5 1000
Sub5 1500
Sub5 1800
Sub5 2000
0 3
0 15
0 25
77 83 89 95 102 109 116
Length
77 83 89 95 102 109 116
Length

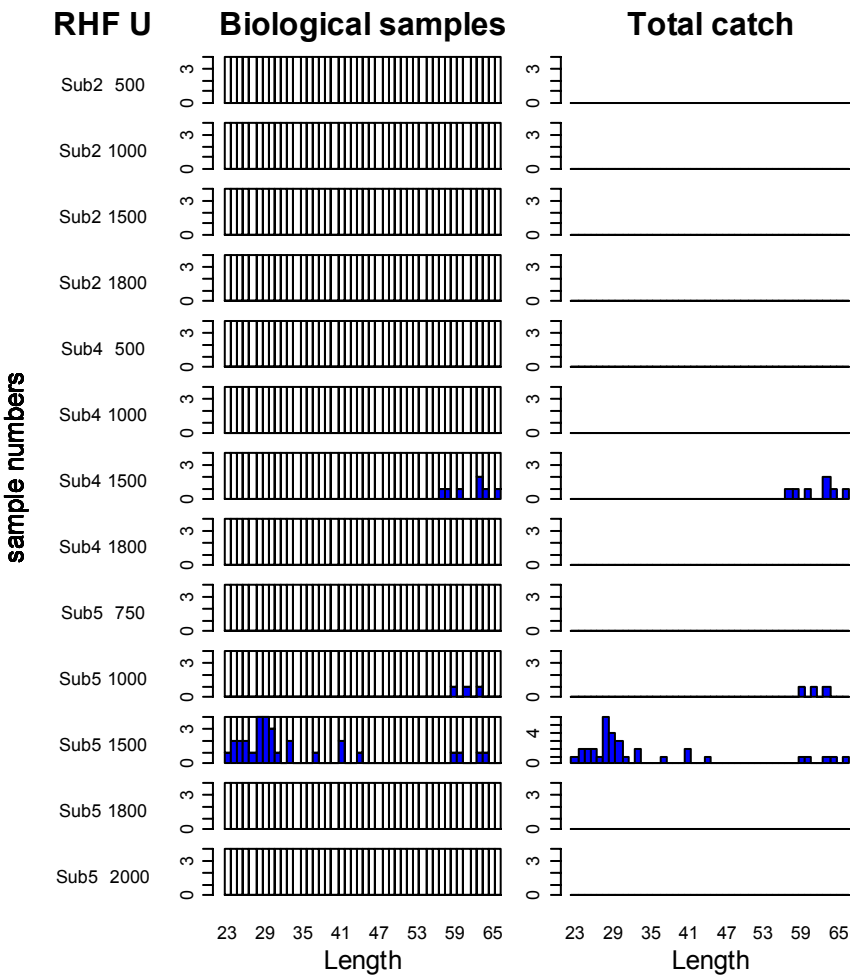

CSQ F
Biological samples
Total catch
sample numbers
Sub2 500
Sub2 1000
Sub2 1500
Sub2 1800
Sub4 500
Sub4 1000
Sub4 1500
Sub4 1800
Sub5 750
Sub5 1000
Sub5 1500
Sub5 1800
Sub5 2000
0 6
95 98 102 106 110 114
Length

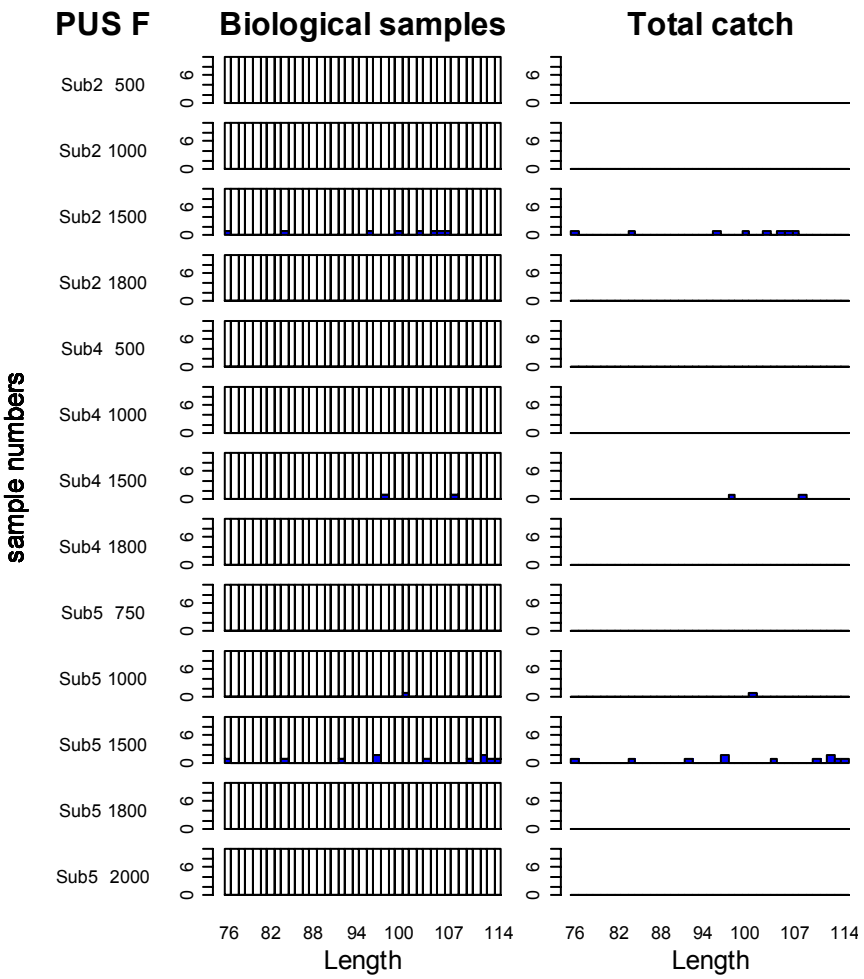

CSQ M
Biological samples
Total catch
sample numbers
Sub2 500
Sub2 1000
Sub2 1500
Sub2 1800
Sub4 500
Sub4 1000
Sub4 1500
Sub4 1800
Sub5 750
Sub5 1000
Sub5 1500
Sub5 1800
Sub5 2000
0 6
95 98 102 106 110 114
Length

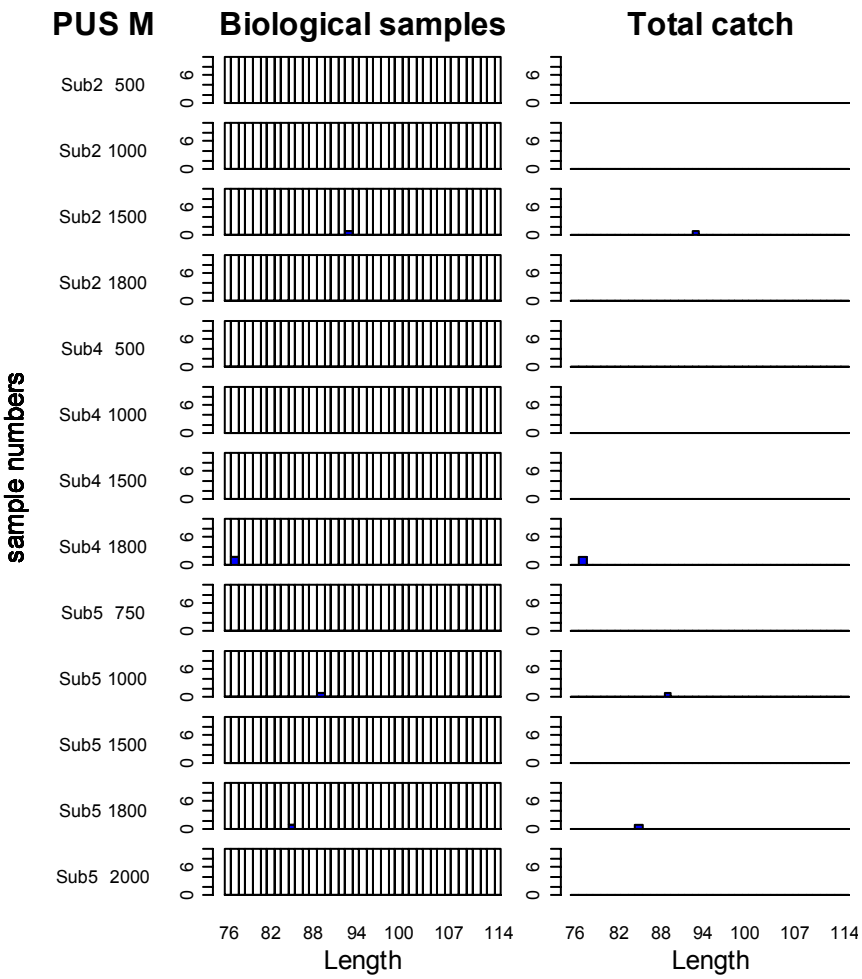

HKE U
Biological samples
Total catch
sample numbers
Sub2 500
Sub2 1000
Sub2 1500
Sub2 1800
Sub4 500
Sub4 1000
Sub4 1500
Sub4 1800
Sub5 750
Sub5 1000
Sub5 1500
Sub5 1800
Sub5 2000
0 3
0 25
0 15
35 43 51 59 67 75 83 91
Length

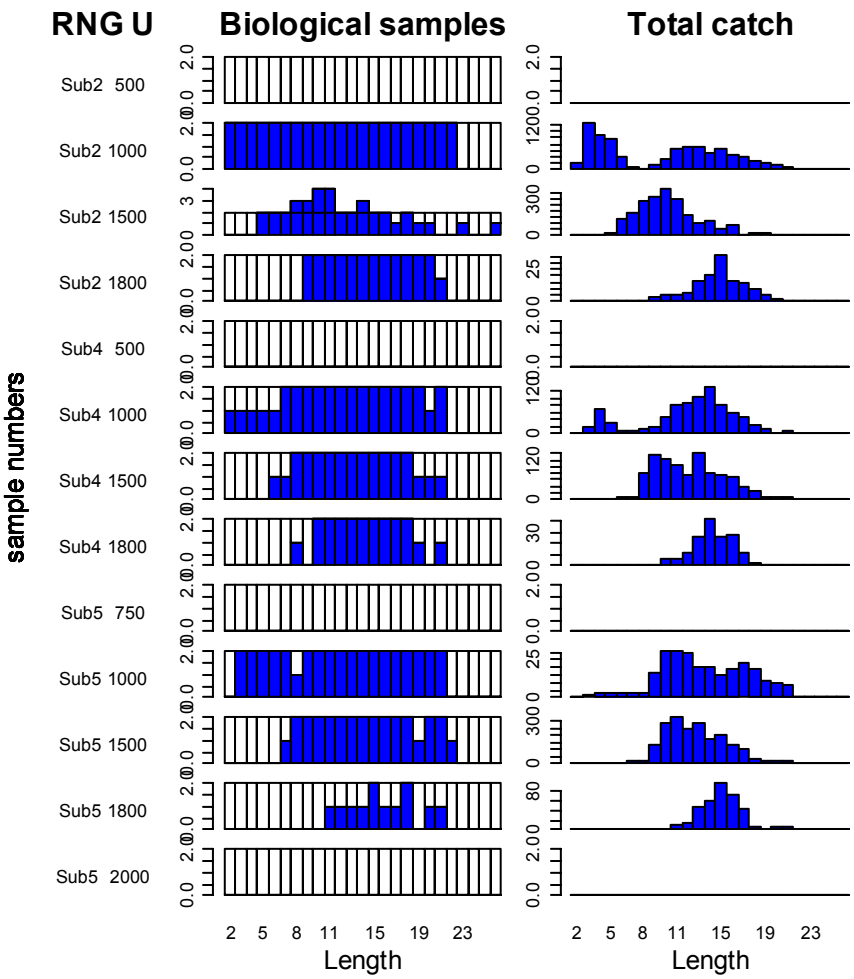

LIN U
Biological samples
Total catch
sample numbers
Sub2 500
Sub2 1000
Sub2 1500
Sub2 1800
Sub4 500
Sub4 1000
Sub4 1500
Sub4 1800
Sub5 750
Sub5 1000
Sub5 1500
Sub5 1800
Sub5 2000
0 3
75 81 87 93 99 106 114
Length
75 81 87 93 99 106 114
Length


MON U
Biological samples
Total catch
sample numbers
Sub2 500
Sub2 1000
Sub2 1500
Sub2 1800
Sub4 500
Sub4 1000
Sub4 1500
Sub4 1800
Sub5 750
Sub5 1000
Sub5 1500
Sub5 1800
Sub5 2000
0 3
44 53 62 71 80 89 98 108
Length
Length


RHF U
Biological samples
Total catch
sample numbers
Sub2 500
Sub2 1000
Sub2 1500
Sub2 1800
Sub4 500
Sub4 1000
Sub4 1500
Sub4 1800
Sub5 750
Sub5 1000
Sub5 1500
Sub5 1800
Sub5 2000
0 3
0 4
23 29 35 41 47 53 59 65
Length


PUS F
Biological samples
Total catch
sample numbers
Sub2 500
Sub2 1000
Sub2 1500
Sub2 1800
Sub4 500
Sub4 1000
Sub4 1500
Sub4 1800
Sub5 750
Sub5 1000
Sub5 1500
Sub5 1800
Sub5 2000
0 6
76 82 88 94 100 107 114
Length
Length


PUS M
Biological samples
Total catch
sample numbers
Sub2 500
Sub2 1000
Sub2 1500
Sub2 1800
Sub4 500
Sub4 1000
Sub4 1500
Sub4 1800
Sub5 750
Sub5 1000
Sub5 1500
Sub5 1800
Sub5 2000
0 6
76 82 88 94 100 107 114
Length
Length


RNG U
Biological samples
Total catch
sample numbers
Sub2 500
Sub2 1000
Sub2 1500
Sub2 1800
Sub4 500
Sub4 1000
Sub4 1500
Sub4 1800
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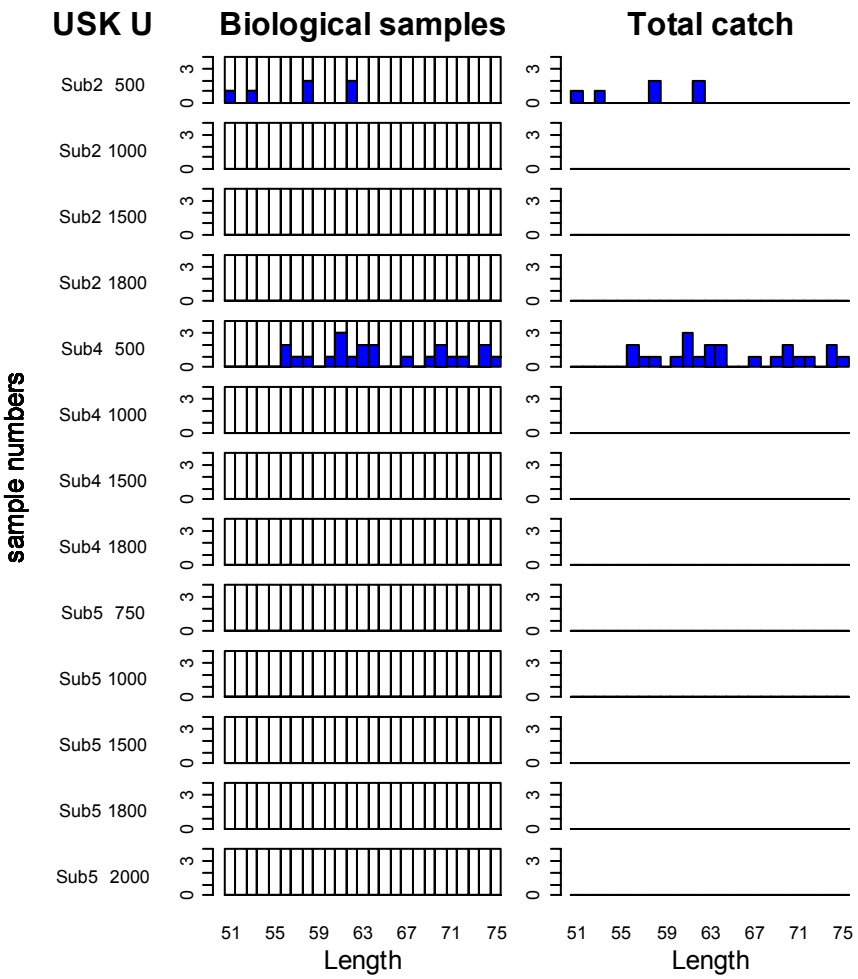
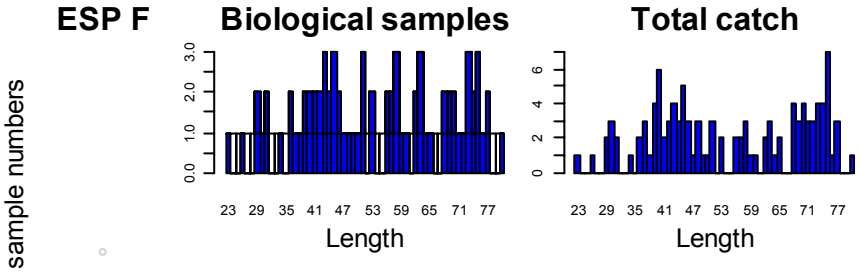
Sub5 2000
2 5 8 11 15 19 23
Length
2 5 8 11 15 19 23
Length


USK U
Biological samples
Total catch
sample numbers
Sub2 500
Sub2 1000
Sub2 1500
Sub2 1800
Sub4 500
Sub4 1000
Sub4 1500
Sub4 1800
Sub5 750
Sub5 1000
Sub5 1500
Sub5 1800
Sub5 2000
0 3
51 55 59 63 67 71 75
Length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Biological samples
Total catch
sample numbers
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0 2 4 6
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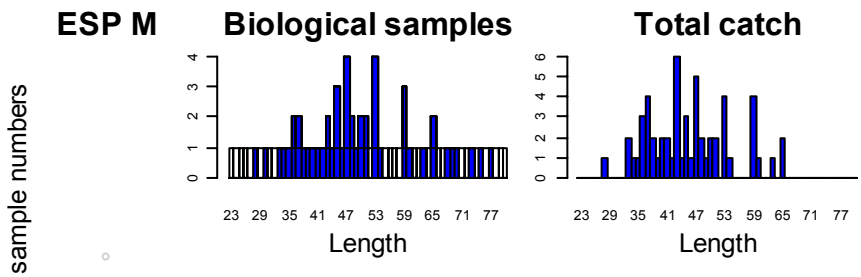
Length


ESP M
Biological samples
Total catch
sample numbers
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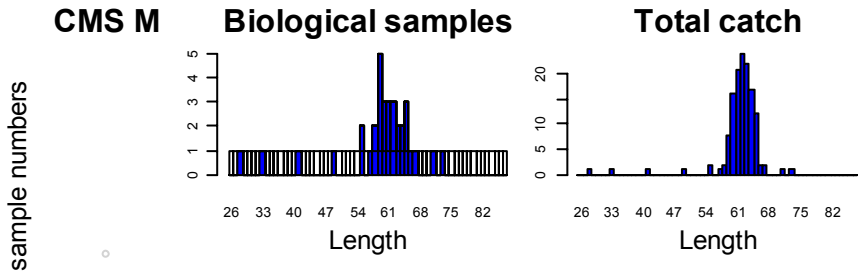
Length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Length
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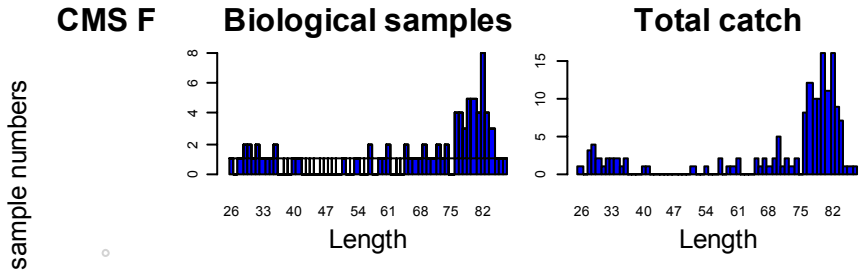
Length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Length
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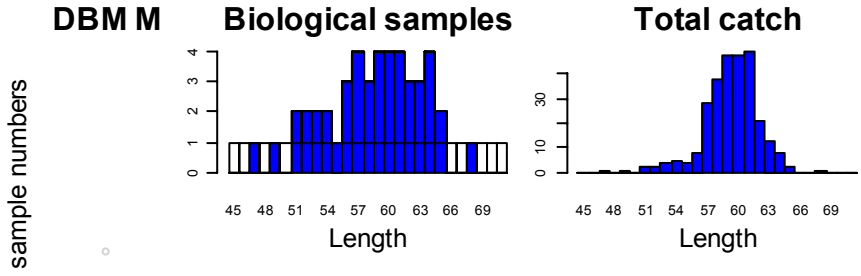
Length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Length
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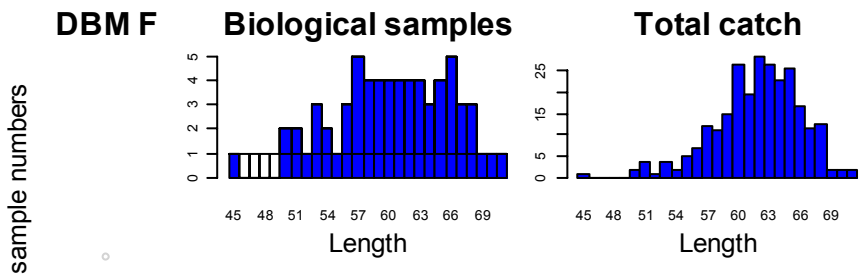
Length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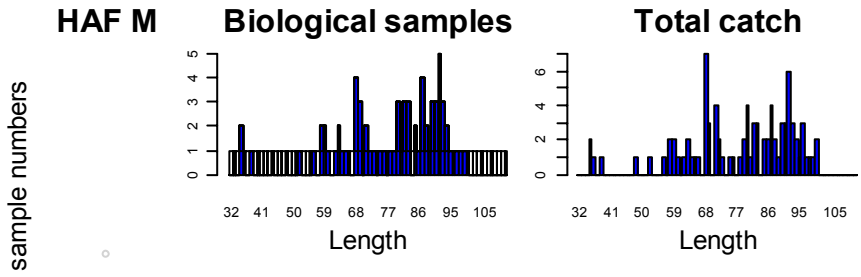
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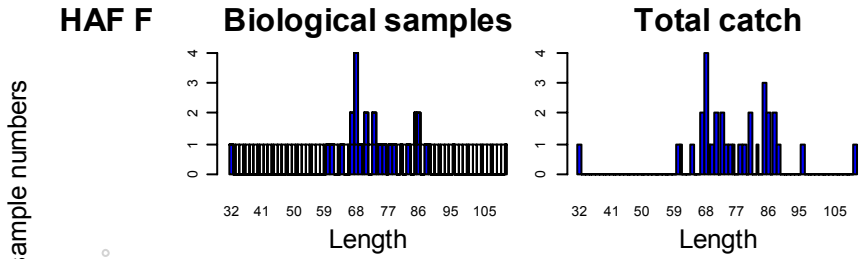
Length


HAF F
Biological samples
Total catch
sample numbers
0 1 2 3 4
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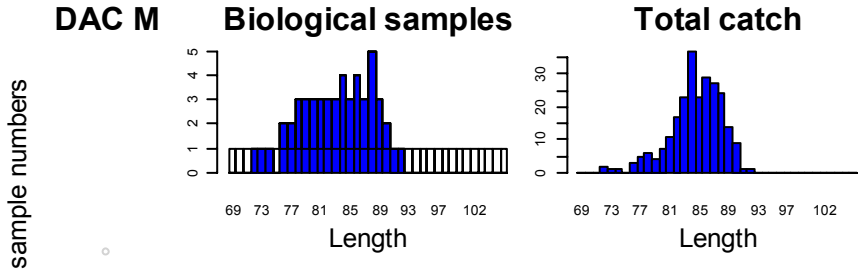
Length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Biological samples
Total catch
sample numbers
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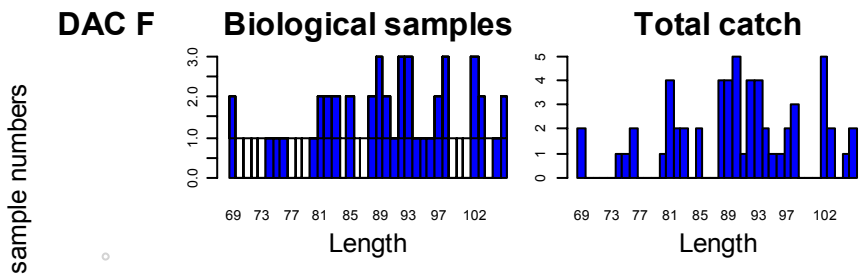
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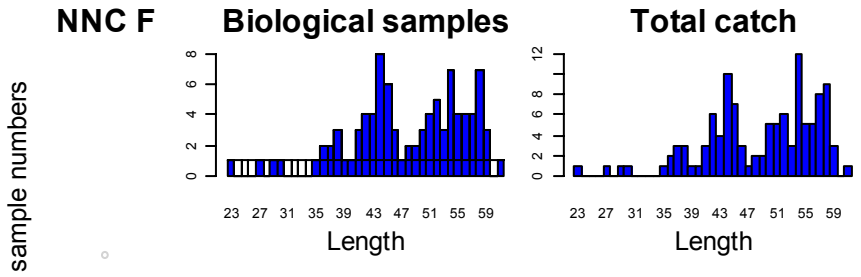
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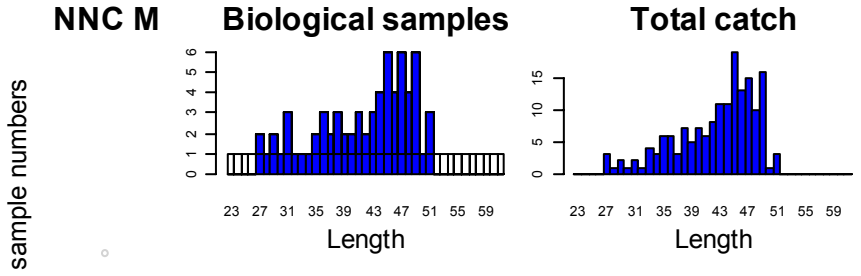
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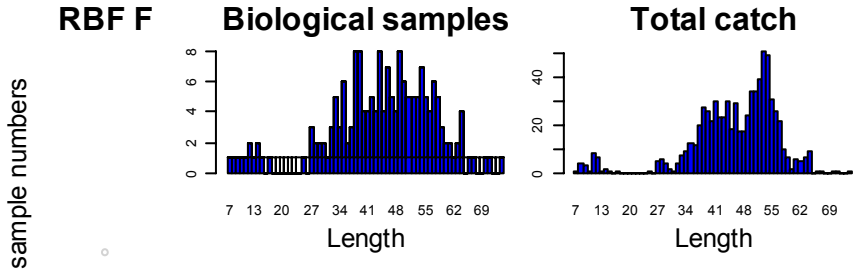
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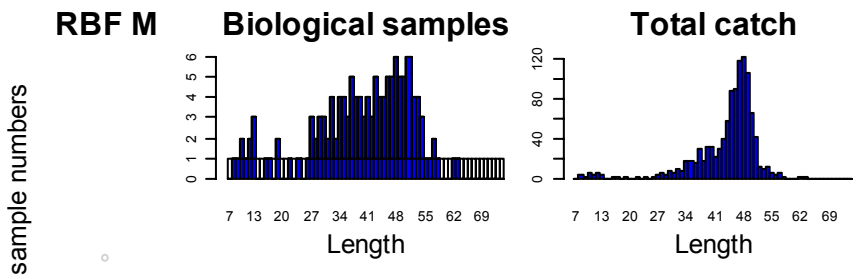
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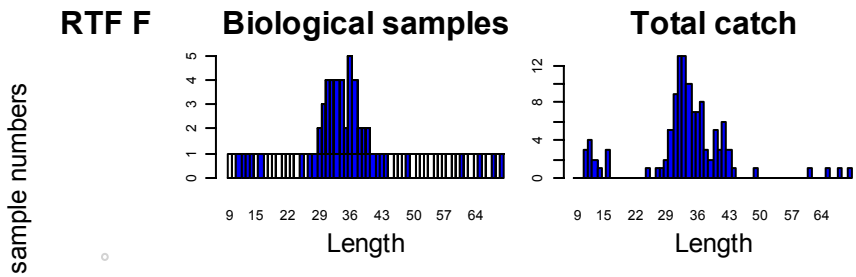
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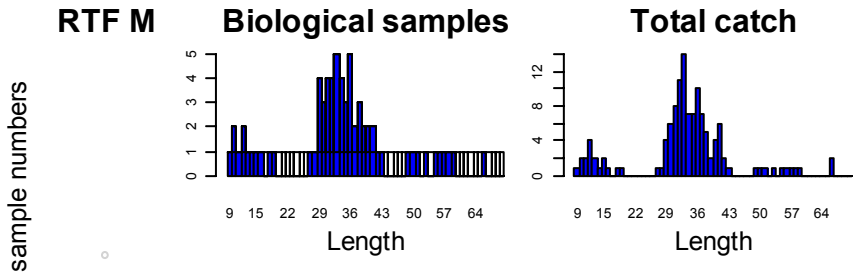
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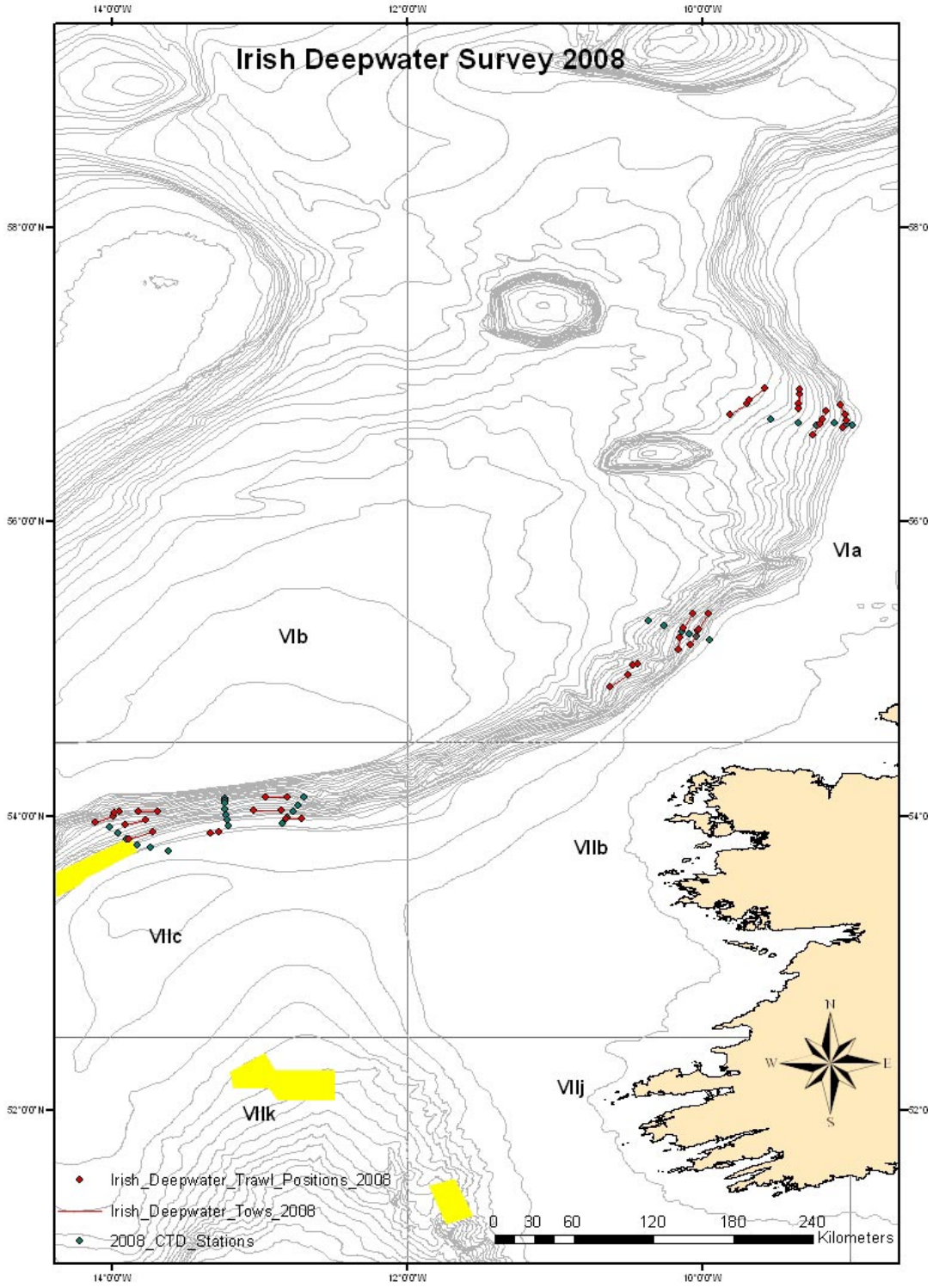


**Figure 1.** 2008 trawl positions and CTD stations

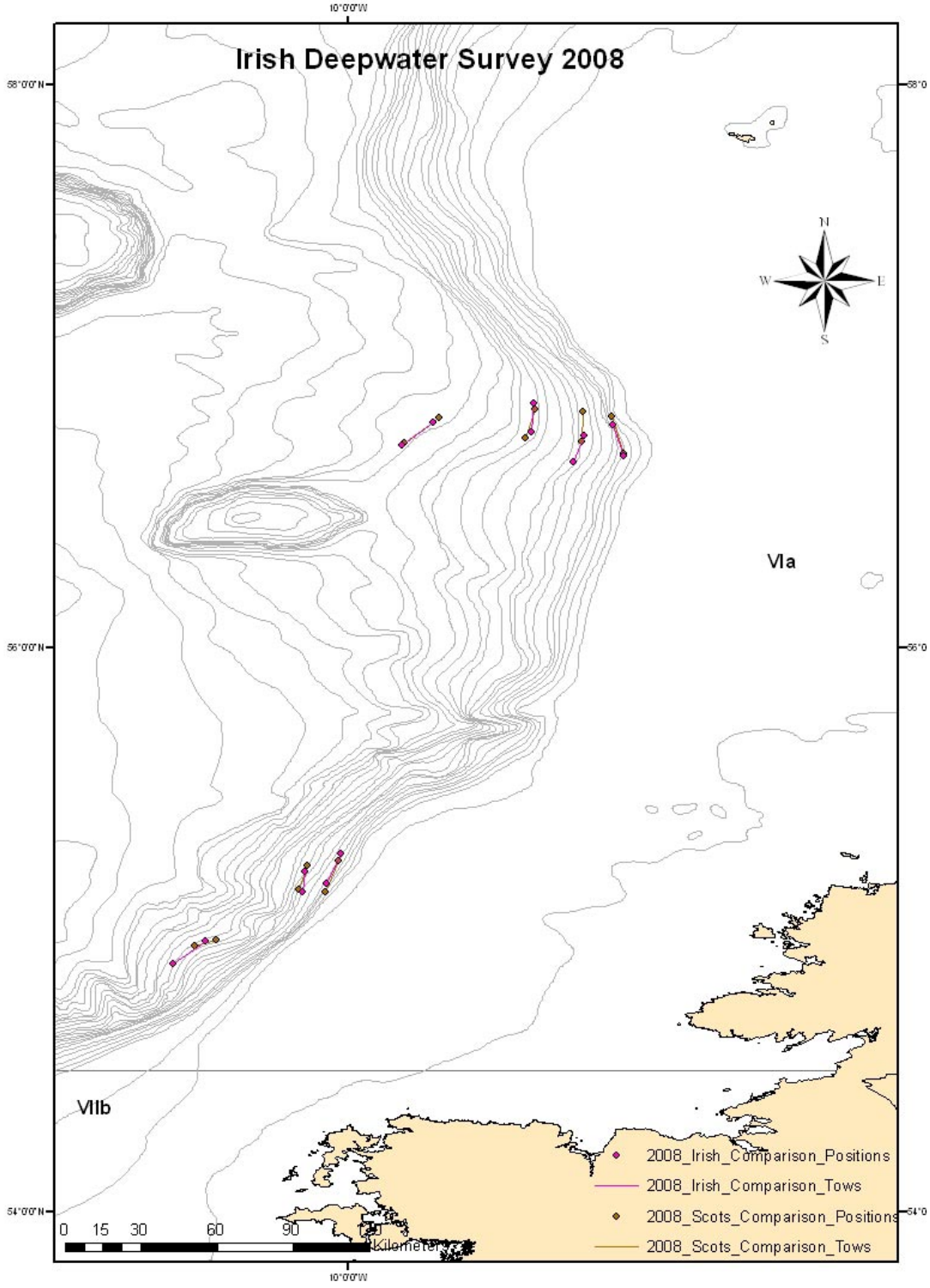


**Figure 2.** Comparative tows between the *Celtic Explorer* and the *Scotia*

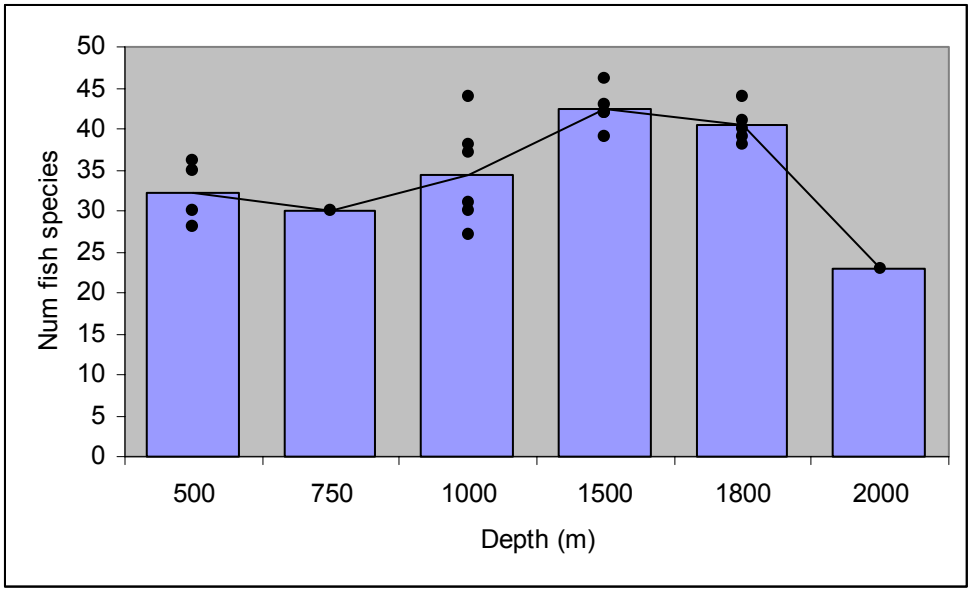


**Figure 3**. Species number per depth for trawl sites. The number of fish species in the catches was highest around 1500-1800m depth

# Appendix 1

Daily log

| Date | Events |
|---|---|
| **Tuesday, Sept 9th:** | Mobilisation started at 11.00.<br><br>All scientists were aboard by 16.00. The safety briefing was given by the Second Mate, and survival and medical certificates were checked. |
| **Wednesday, Sept 10th:** | We left Galway at 02.30. Christian Mohn carried out two ADCP transects across Galway Bay near Black Head to calibrate the instrument.<br><br>A scientific briefing was held at 13.00, and the work programme was sorted out. Staff were briefed on the detail of the length measurements for the various species we were collecting, and also the numbers of otoliths to be collected per species. Staff were also told of the samples we had been asked to collect for external researchers. Christian Mohn spoke of his proposed work programme, and again mentioned extra samples he would be collecting.<br><br>A trial tow was carried out in Donegal Bay at 54° 31.29N, 9° 59.68W, to ensure the gear was working properly. This was a known Groundfish tow with good ground. Problems were encountered with the door sensors which were subsequently solved. The commercial fish caught were sampled for otoliths, to help with Area VIa sampling targets.<br><br>We then steamed north to survey area 2, west of the Hebredies. During the evening meeting with the Skipper and Mate the following days work programme was agreed on. |
| **Thursday, Sept 11th:** | We arrived on station at 03.00.<br><br>**Haul No. 1.**<br>The trawl was shot at position 56º 45.06N 009º 52.03W at 07.00 in 516m depth. The trawl touched bottom at 07.15, at position 56° 43.79N 009° 02.035W. It was hauled at 09.15 at position 56º 38.147N 009º 03.061W.<br><br>The Trawleye was only returning occasional signals. It was decided to modify its safety bag before the next haul.<br><br>**Haul No. 2.**<br>The trawl was shot at position 56º 47.251N 009º 10.218W at 11.30 in 1022m depth. The trawl touched bottom at 11.48, at position 56° 45.233N 009° 09.811W. It was hauled at 13.48 at position 56º 39.743N 009º 12.079W.<br><br>Once again the Trawleye was giving problems. The Scanmar system was rebooted which solved this. All sensors started logging data correctly.<br><br>**Haul No. 3.**<br>The trawl was shot at position 56º 44.779N 009º 12.131W at 15.30 in 1451m depth. The trawl touched bottom at 16.15, at position 56° 48.084N 009° 20.873W. It was hauled at 18.15 at position 56º 53.625N 009º 20.472W.<br><br>CTD's were conducted later in the night at four depths. It was decided to use the same positions as last year, just leaving out the station at 2000m. Bongo nets were lowered to 100m and hauled back to collect plankton samples.<br><br>Cast 1 750m 56º 39.96N 009º 06.12W<br>Cast 2 1000m 56º 39.06N 009º 13.50W<br>Cast 3 1250m 56º 40.20N 009º 20.10W<br>Cast 4 1500m 56º 41.70N 009º 32.16W |

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| | All casts were successful. |
| **Friday, Sept 12th:** | **Haul No. 4.**<br>The trawl was shot at position 56º 51.290N 009º 38.268W at 06.58 in 1820m depth. The trawl touched bottom at 07.50, at position 56° 48.111N 009° 42.112W. It was hauled at 09.50 at position 56º 43.355N 009º 48.714W.<br><br>We lost transmission from the Scanmar sensors. This may be due to the angle being too shallow or the transmission distance too long. The sensors came back on line as the net was being hauled, however the Trawleye was sending back a very weak signal. Four floats were lost during the tow.<br><br>**Haul No. 5.**<br>The trawl was shot at position 56º 55.044N 009º 20.630W at 12.50 in 1445m depth. The trawl touched bottom at 13.27, at position 56° 52.093N 009° 20.575W. It was hauled at 15.27 at position 56º 46.045N 009º 21.110W.<br><br>The Trawleye continued to return a weak data during the tow, and only gave occasional readings. It was changed before haul 6.<br><br>**Haul No. 6.**<br>The trawl was shot at position 56º 49.197N 009º 04.686W at 17.16 in 519m depth. The trawl touched bottom at 17.38, at position 56° 47.575N 009° 03.767W. It was hauled at 19.38 at position 56º 40.952N 009º 01.368W.<br><br>The second Trawleye returned a strong signal. However the height readings were only 50% of what was expected. We reset the programme and this should solve the problem. We put the original Trawleye back on for the 1800m tow in the morning.<br><br>The last two CTD's on the track were carried out, along with the Bongo plankton samples.<br><br>Cast 5 200m 56º 39.30N 008º 58.98W<br>Cast 6 450m 56º 39.54N 009º 01.26W<br><br>As we steamed west to the 1800m fishing site we repeated the four deeper CTD stations from the 11th, without doing the Bongo hauls. |
| **Saturday, Sept 13th:** | **Haul No. 7.**<br>The trawl was shot at position 56º 57.353N 09º 30.981W at 06.47 in 1777m depth. The trawl touched bottom at 07.43, at position 56º 54.389N 09º 34.591W. It was hauled at 09.43 at position 56º 49.263N 09º 40.808W.<br><br>We lost the Trawleye signal once we had 2800m of wire out again. The footrope signal was a bit stronger than last night, but again the sensor wouldn't transmit height and clearance data. The signal reappeared as the net came within 1500m of the boat. We changed over to the second Trawleye for the next tow.<br><br>Eleven floats were broken during this haul. The holes appeared in the eye of the net where the rope goes through. There is no appearance of chaffing due to rope wear. It seems as if there is a seam in the middle of the eye which is giving way. We decided to leave the 1800m tows until the end of sampling in each area. We've used most of our spare floats at this stage, and will have to start taking them off the spare net if we suffer much more damage.<br><br>**Haul No. 8.**<br>The trawl was shot at position 56º 43.855N 009º 09.744W at 12.43 in 1009m depth. The trawl touched bottom at 13.18, at position 56º 41.396N 009º 11.043W. It was hauled at 15.18 at position 56º 35.457N 009º 15.057W.<br><br>The Trawleye sent back good signals. We decided to use this Trawleye for the shallow tows, less than 1000m. The damaged one will be used in deeper waters where we should get some signal, even if it is weak.<br><br>We finished sampling in Area 2 at 16.00 and steamed south to Area 4.<br><br>We made contact with the *RV Scotia* who were sampling in Area 4 as well. We finalised a sampling plan |

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| | where we would fish the same tows in rotation during the day. One 1500m station was dropped from the plan after consultation. The *Explorer* suffered gear damage on this tow in the last two years. This will leave seven stations to be covered in Area 4 as we only have time to search for one new tow at 1800m.<br>. |
| **Sunday, Sept 14th:** | We arrived in Area 4 at 04.30.<br><br>**Haul No. 9.**<br>The trawl was shot at position 55º 24.914N 010º 01.448W at 06.45 in 976m depth. The trawl touched bottom at 07.21, at position 55º 22.535N 010º 03.791W. It was hauled at 09.21 at position 55º 16.570N 010º 07.774W.<br><br>The Scotia contacted us after tow 9 to pass on information regarding difficult ground on tow 10. They only towed for one hour before meeting hard ground. We decided to run our tow in the opposite direction, starting where they finished. We also decided we would only carry out two tows as the distance between the tows was twenty miles, and we would run out of time.<br><br>**Haul No. 10.**<br>The trawl was shot at position 54º 58.580N 010º 24.745W at 12.01 in 1449m depth. The trawl touched bottom at 12.55, at position 54º 57.500N 010º 30.458W. It was hauled at 14.55 at position 54º 52.705N 010º 37.425W.<br><br>The CTD and Bongo net transect was carried out. Five casts were made starting at 2000m.<br><br>Cast 1 2000m 55º 19.50N 010º 21.70W<br>Cast 2 1500m 55º 17.40N 010º 15.54W<br>Cast 3 1000m 55º 15.00N 010º 08.16W<br>Cast 4 750m 55º 14.10N 010º 05.40W<br>Cast 5 450m 55º 13.32N 010º 02.40W |
| **Monday, Sept 15th:** | **Haul No. 11.**<br>The trawl was shot at position 55º 24.228N 010º 56.376W at 06.55 in 650m depth. The trawl touched bottom at 07.18, at position 55º 22.294N 009º 57.448W. It was hauled at 09.18 at position 55º 15.665N 010º 01.779W.<br><br>The sweeps and bridles were strung with longlines when we hauled up. The cod end was badly twisted, but full. The haul contained over 2 tonnes of fish<br><br>**Haul No. 12.**<br>The trawl was shot at position 55º 15.495N 010º 08.541W at 11.18 in 1026m depth. The trawl touched bottom at 12.03, at position 55º 12.516N 010º 09.348W. It was hauled at 13.46 at position 55º 07.971N 010º 09.944W.<br><br>The net lifted briefly after 40 minutes. An extra 200m of wire was let out to sink it back to the bottom.<br><br>After one hour forty minutes the bottom started dropping away quite steeply. It was decided to end the tow early before we got into difficulty. We should run the tow in the opposite direction next year. A large piece of worn fishing net was collected in this haul. Nine floats were burst. This used up the last of our spares.<br><br>**Haul No. 13.**<br>The trawl was shot at position 55º 08.137N 010º 04.955W at 15.20 in 510m depth. The trawl touched bottom at 15.37, at position 55º 09.774N 010º 04.694W. It was hauled at 17.37 at position 55º 16.134N 010º 01.634W.<br><br>This tow was made slightly to the west of last years positions. Information from the Scotia indicated the position of two "fasts" close to last years track which may have led to the damage incurred. Once again we dragged up some longlines on the sweeps and bridles.<br><br>After fishing the CTD's were run again at the same depths as last night, but in the reverse order. This time a station at 250m was included. This was the only station at which a Bongo net sample was collected.<br><br>Cast6 250m 55º 11.90N 009º 56.80W |
| **Tuesday, Sept 16th:** | **Haul No. 14.**<br>The trawl was shot at position 55º 03.593N 10º 19.438W at 07.19 in 1470m depth. The trawl touched |

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| | bottom at 08.20, at position 55º 02.109N 10º 25.981W. It was hauled at 10.20 at position 54º 08.66N 10º 10.19W.<br><br>The net came fast after 40 minutes towing and was hauled quickly. It contained roughly 500kg of fish. The starboard head and footrope was covered in mud, and thirty floats were burst. The floats were replaced with some scavenged from the spare net. This left only 18 on the spare net. It was decided to finish in Area 4 and save the floats for Area 5.<br><br>This finished the fish sampling in Area 4, so we moved to Area 5. Large numbers of whales were encountered during this transit. We arrived in Area 5 at 21.30. |
| **Wednesday, Sept 17th:** | The hauls in Area 5 are split by a deep canyon. It was decided to fish on the western end of the area first. When we arrived in the Area we ran a CTD transect through the canyon, starting at 2000m and finishing at 500m.<br><br>Cast 1 2000m 54º 07.40N 013º 14.50W<br>Cast 2 1750m 54º 06.30N 013º 14.50W<br>Cast 3 1500m 54º 05.10N 013º 14.40W<br>Cast 4 1250m 54º 02.90N 013º 14.20W<br>Cast 5 1000m 54º 00.50N 013º 13.90W<br>Cast 6 750m 53º 58.40N 013º 13.60W<br>Cast 7 500m 53º 55.90N 013º 13.10W<br><br>**Haul No. 15.**<br>The trawl was shot at position 53º 54.143N 013º 14.494W at 06.47 in 425m depth. The trawl touched bottom at 07.04, at position 53º 53.649N 013º 16.925W. It was hauled at 07.42 at position 53º 53.125N 013º 20.306W.<br><br>After forty minutes the data from the trawl sensors disappeared. We started hauling and noticed increased pressure on one of the winches. When we hauled the net aboard both the starboard bridles had snapped and there was some damage to the wing. The bridles were replaced and the net was repaired. The haul was declared a foul haul and the catch was discarded.<br><br>The Spanish research vessel, the Vizconde de Eza, was in the area. They provided us with a 500m tow in the area which we hope to use before we head home. They advised us that they have suffered damage on the tow in the past, but other years it is fine.<br><br>**Haul No. 16.**<br>The trawl was shot at position 53º 54.647N 013º 39.654W at 11.03 in 1034m depth. The trawl touched bottom at 11.35, at position 53º 53.664N 013º 43.658W. It was hauled at 13.35 at position 53º 50.803N 013º 53.600W.<br><br>**Haul No. 17.**<br>The trawl was shot at position 53º 55.405N 014º 00.719W at 15.20 in 1483m depth. The trawl touched bottom at 16.30, at position 53º 56.736N 013º 55.127W. It was hauled at 18.30 at position 53º 58.544N 013º 46.677W.<br><br>We steamed to the east of the Area to carry out a CTD and Bongo net transect. We arrived on station at 23.15, and five casts were carried out.<br><br>Cast 1 500m 53º 57.06N 012º 50.76W<br>Cast 2 750m 53º 59.40N 012º 49.02W<br>Cast 3 1000m 54º 01.92N 012º 46.92W<br>Cast 4 1250m 54º 04.50N 012º 44.80W<br>Cast 5 1500m 54º 08.04N 012º 42.48W |
| **Thursday, Sept 18th:** | **Haul No. 18.**<br>The trawl was shot at position 54º 08.083N 012º 42.960W at 06.50 in 1504m depth. The trawl touched bottom at 07.45, at position 54º 07.851N 012º 48.859W. It was hauled at 09.45 at position 54º 07.570N 012º 57.611W.<br><br>The wind was quite strong so we towed from east to west.<br><br>**Haul No. 19.** |

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| | The trawl was shot at position 54º 02.229N 012º 47.603W at 12.00 in 1040m depth. The trawl touched bottom at 12.35, at position 54º 02.236N 012º 51.570W. It was hauled at 14.35 at position 54º 02.215N 013º 02.575W.<br><br>As we were transiting to station 20 both main engines suffered power loss for a couple of minutes. The skipper cancelled fishing operations until the engineers had a chance to identify the problem. At the evening meeting the chief engineer said that the port engine lost power which overloaded the starboard engine momentarily. Depending on the weather fishing could restart in the morning using the starboard and middle engines.<br><br>A CTD transect was run in the western side of the area during the night. No bongo net samples were collected.<br><br>Cast 1 A5W-1250 1250m 53º 53.16N 013º 57.90W<br>Cast 2 A5W-1000 1000m 53º 50.70N 013º 54.30W<br>Cast 3 A5W-750 750m 53º 48.24N 013º 49.98W<br>Cast 4 A5W-500 500m 53º 47.34N 013º 44.58W<br>Cast 5 A5W-350 350m 53º 45.48N 013º 37.26W |
| **Friday, Sept 19th:** | **Haul No. 20.**<br>The trawl was shot at position 53º 58.468N 012º 40.643W at 08.15 in 683m depth. The trawl touched bottom at 08.37, at position 53º 58.860N 012º 43.360W. It was hauled at 10.02 at position 53º 59.121N 012º 49.511W.<br><br>This tow was a repeat of one carried out last year. After one hour and twenty five minutes the net came fast. It was quickly hauled. Once aboard the headline was broken, and there was some mesh damage. This was all repaired as we steamed to the next station.<br><br>It was very difficult to find a tow at 500m. We looked at the area given to us by the Vizconde de Eza, but the ground was very rough, and their tow was short. We decided not to risk our gear at this depth.<br><br>As we transited to the 1800m tow the engineers carried out further tests on the engines. There were still problems with the port engine. We decided to carry out the 1800m tow and work on the engine later in the evening.<br><br>**Haul No. 21.**<br>The trawl was shot at position 54º 00.717N 013º 54.545W at 14.50 in 1799m depth. The trawl touched bottom at 15.47, at position 53º 59.794N 013º 59.912W. It was hauled at 17.47 at position 53º 57.636N 014º 07.125W.<br><br>5 floats were burst.<br><br>A decision was made that due to the problems with the port engine that the survey would finish in Killybegs rather than Galway.<br><br>CTD's were carried out at the same positions as last night. An extra station was carried out at 1500. |
| **Saturday, Sept 20th:** | **Haul No. 22.**<br>The trawl was shot at position 54º 00.607N 013º 55.676W at 07.16 in 1809m depth. The trawl touched bottom at 08.15, at position 54º 01.748N 013º 49.540W. It was hauled at 10.15 at position 54º 02.091N 013º 41.577W.<br>Three floats burst.<br><br>This concluded the survey. As we still had a bit of time to spare we decided to carry out a one hour tow at 2000m. We had hoped to do this last year but ran out of time.<br><br>**Haul No. 23.**<br>The trawl was shot at position 54º 03.413N 013º 50.505W at 12.14 in 2041m depth. The trawl touched bottom at 13.30, at position 54º 02.040N 013º 57.416W. It was hauled at 14.03 at position 54º 01.602N 013º 59.541W.<br><br>Many of the remaining floats burst at this depth |

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| | Once the net was hauled we started on a dog-leg ADCP transect across the Porcupine Bank for Christian Mohn. This will end when we reach Killybegs. |
| **Sunday, Sept 21st:** | We continued steaming along the ADCP track. |
| **Monday, Sept 22nd:** | The ship arrived in Killybegs at 07.00. Scientists left the ship at 11.00. |

PReCAST

**R.V. Celtic Explorer – FSS Deepwater Survey**

# Cetacean Distribution & Relative Abundance Survey

9 September – 22 September 2008

***Blue Whale Fluking, Porcupine Bank (© Dave Wall)***


**Surveyor:** Dave Wall

**Ship Surveys Programme**
**Irish Whale and Dolphin Group**

**Marine Biodiversity Research Group**
**Galway-Mayo Institute of Technology**


IWDG www.iwdg.ie
The Irish Whale and Dolphin Group

GALWAY-MAYO INSTITUTE OF TECHNOLOGY
Marine Biodiversity Research Group

## Introduction

The waters of Ireland's Exclusive Economic Zone (EEZ) are thought to represent one of the most important cetacean (whales, dolphins and porpoise) habitats in Europe. To date 24 species of cetacean have been recorded (Appendix I), with seven of these having been confirmed as calving within the Irish EEZ, while a number of other species are possibly calving (e.g. minke whale and northern bottlenose whale) (Berrow 2001). In recognition of their importance for cetaceans, the Irish government declared all Irish waters (within the EEZ) to be a whale and dolphin sanctuary in 1991 (Rogan and Berrow 1995). Despite this recognition, information on the distribution and relative abundance of cetaceans within the Irish EEZ, especially in offshore waters, is very limited (Wall *et al.* 2006).

The Irish Whale and Dolphin Group (IWDG) have been collecting data on the distribution and relative abundance of cetaceans in Irish waters (including Northern Ireland) since 1991. The IWDG casual and constant effort sightings schemes record data mainly from land-based sightings and surveys (Berrow *et al.* 2001). The IWDG has conducted cetacean surveys on board commercial ferries since 2001 and on board the Irish Marine Institute's offshore research vessel *'Celtic Explorer'* since 2003.

In 2008, the IWDG in collaboration with the Galway-Mayo Institute of Technology commenced PReCAST, a three-year project (2008-2011) which aims to provide robust scientific data to support conservation policy and provide guidance to state agencies in implementing national and international obligations. PReCAST is committed to gaining a more complete understanding of the seasonal distribution, relative abundance and habitat use of cetaceans within the Irish EEZ.

As part of this project the a cetacean distribution and relative abundance survey was conducted on board the *RV Celtic Explorer* during the Marine Institute's 2008 FSS Deepwater Survey.

## Methods

The survey was conducted on board the *R.V. Celtic Explorer* as an ancillary project of the FSS Deepwater Survey between 9 September and 22 September 2008. The survey area covered waters over the Irish & UK continental shelf slopes and northern slopes of the Porcupine Bank (Fig. 1). The survey areas were opportunistic and based on predetermined locations chosen by the Marine Institute for the 2008 FSS Deepwater Survey.

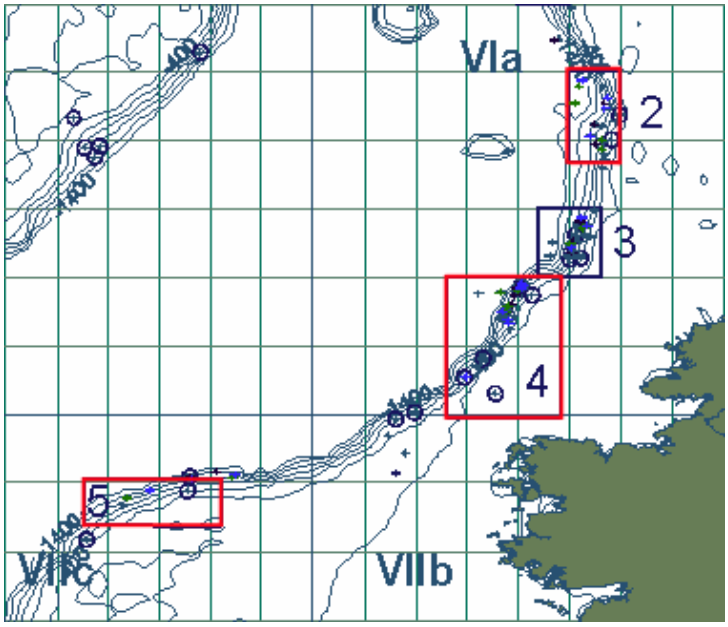


**Fig. 1:** FSS Deep Water Survey 2008. (Survey Areas 2, 4 & 5)

A single marine mammal observer was present on board during the survey and conducted watches from the 'crow's nest' located above the bridge, 18m above sea level. Observer effort focused on a 90 degree arc ahead of the ship; however sightings located up to 90 degrees to port and starboard were also included. The observer scanned the area by eye and using 10 X 40 binoculars. Bearings to sightings were measured using an angle board and distances were estimated with the aid of distance measuring stick. Environmental data were recorded every 15 minutes using Logger 2000 software (IFAW 2000). Sightings were also recorded using Logger 2000. Automated position data were obtained through a laptop computer linked to a feed from the ships GPS.

The survey vessel travelled at an average speed of 10 knots when steaming and 2.5-3.5 knots when trawling. The vessel alternated between trawling and steaming to the start of the next towline during daylight hours. Tows lasted on average 120 minutes (in addition to 30-60mins for deploying and retrieving the net) and the majority of the day was spent trawling. CTDs and plankton stations were conducted during the hours of darkness.

Surveying was conducted up to Beaufort sea-state 6 and in visibility ≥500m. As this was a survey onboard a vessel of opportunity, the survey was conducted in 'passing mode' and cetaceans sighted were not approached (with the exception of one case in which a sighting of a blue whale resulted in an approach to photograph the animal for the purposes species identification). Sightings were identified to species level where possible, with species identifications being graded as definite, probable or possible. Where species identification could not be confirmed, sightings were downgraded (e.g. unidentified dolphin / unidentified whale / unidentified beaked whale etc.) according to criteria established for the IWDG's cetacean sightings database (IWDG 2008).

# Results

### *Environmental Conditions*

Environmental data was collected at 291 stations. Survey conditions were generally good, with sea state ≤ 3 at 40.2% of environmental stations and ≤ 4 at 63.2% of stations. Visibility was good (>5km) at 70.1% of stations, moderate (1–5km) at 18.6% of stations and poor (<1km) at 11.3% of stations. A heavy swell (2m+) was recorded at 45.7% of stations, generated by depressions to the west and north of the survey area. Rainfall was recorded at 15.5% of stations and fog/mist was recorded at 10.3% of stations (fig. 2). Two full survey days were lost due to bad weather (sea state 6+ and/or very heavy swell).

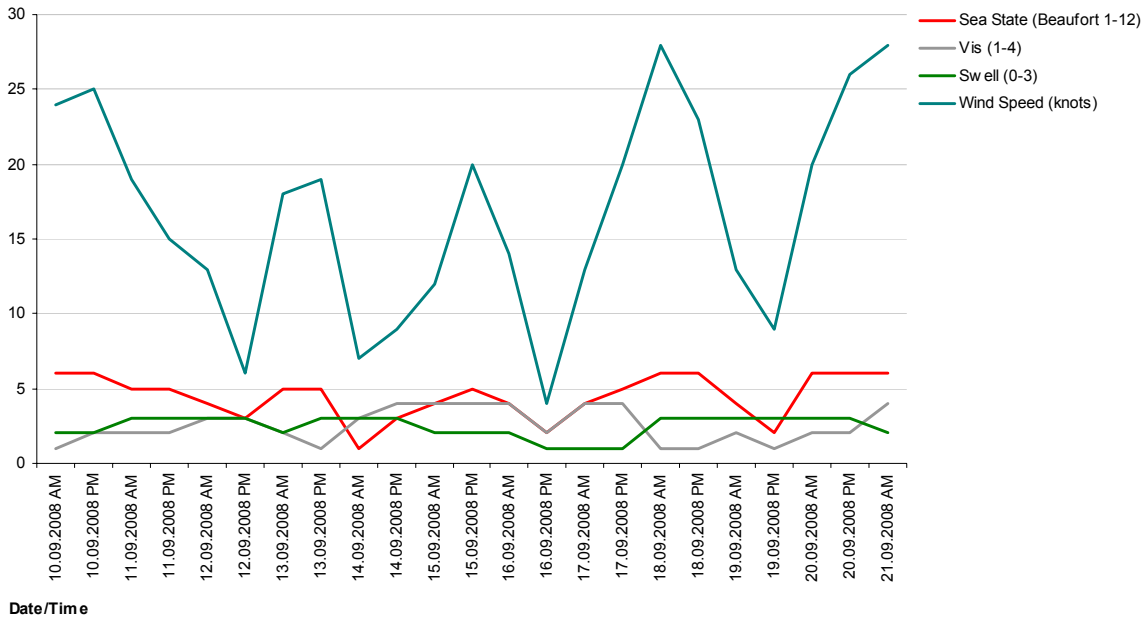


**Fig. 2:** Sea state, swell conditions and wind speed recorded twice daily during the survey.

***Cetacean Survey Results***

61.9 hours of survey time were logged with 41.2% (25.5 hrs) of this at Beaufort sea state three or less and 63.5% (39.3 hrs) at Beaufort sea state four or less. 77 sightings of at least eight cetacean species, totalling 757 individuals were recorded (fig. 3).

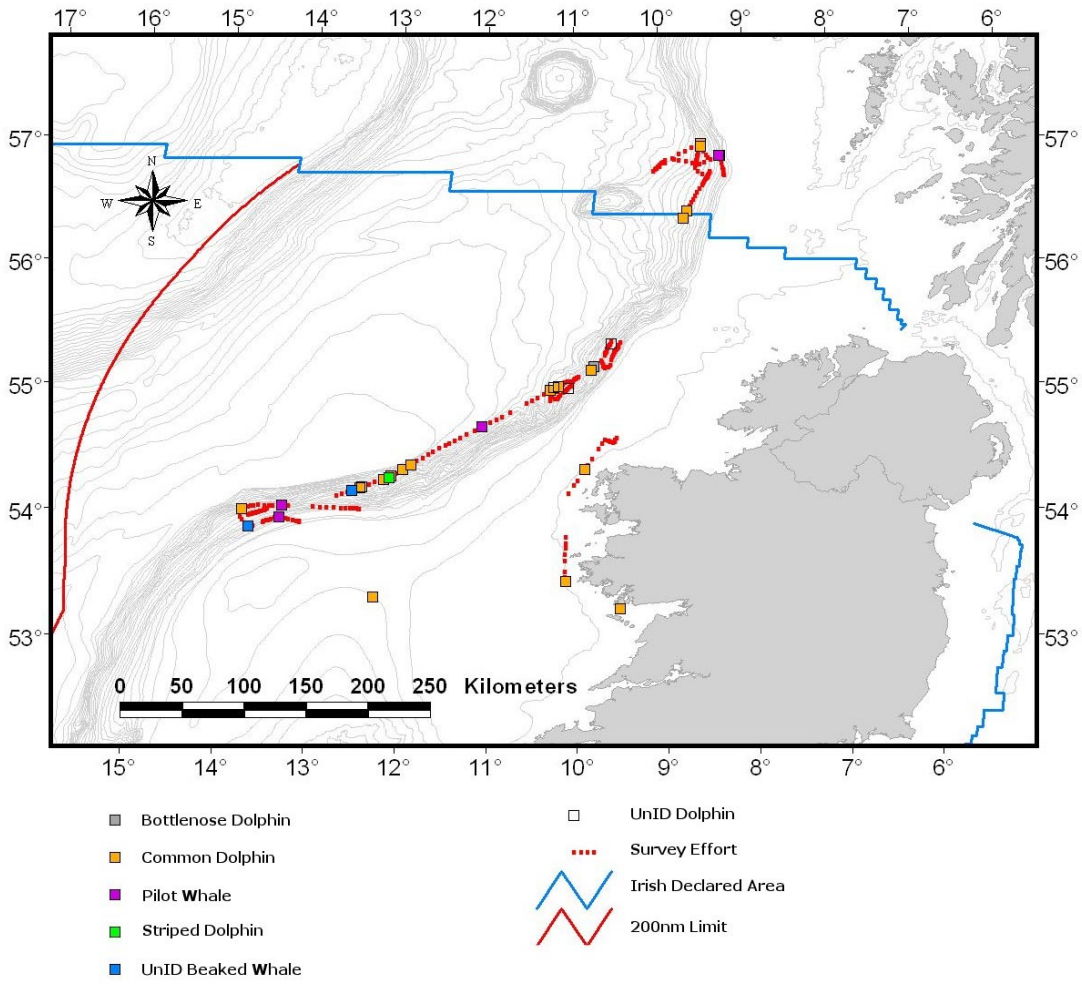


**Fig. 3** Distribution of sightings of dolphin species recorded during the current survey

Identified dolphin species were bottlenose dolphin (*Tursiops truncatus*), common dolphin (*Delphinus delphis*), pilot whale (*Globicephala melas*) and Striped dolphin (*Stenella coeruleoalba*).

The presence of striped dolphins on the north slopes of the Porcupine Bank has not been recorded before during these surveys, though O'Cadhla *et al.* (2004) did record their presence over the central Porcupine Bank during their surveys 1999-2001. It is

also noteworthy that this group of striped dolphins rapidly moved away northward as a group of common dolphins approached from the south.

Two sightings of breaching beaked whales (animals were too distant for identification to species) occurred on the north slopes of the Porcupine, in roughly the same areas as observed in previous year and lending more weight to the argument that the northern slopes of the Porcupine Bank and their associated canyon systems are an important habitat for these little understood species.

Four groups of dolphins sighted could not be identified to species due either to the distance at which the sighting was made or to the short duration of the encounter.

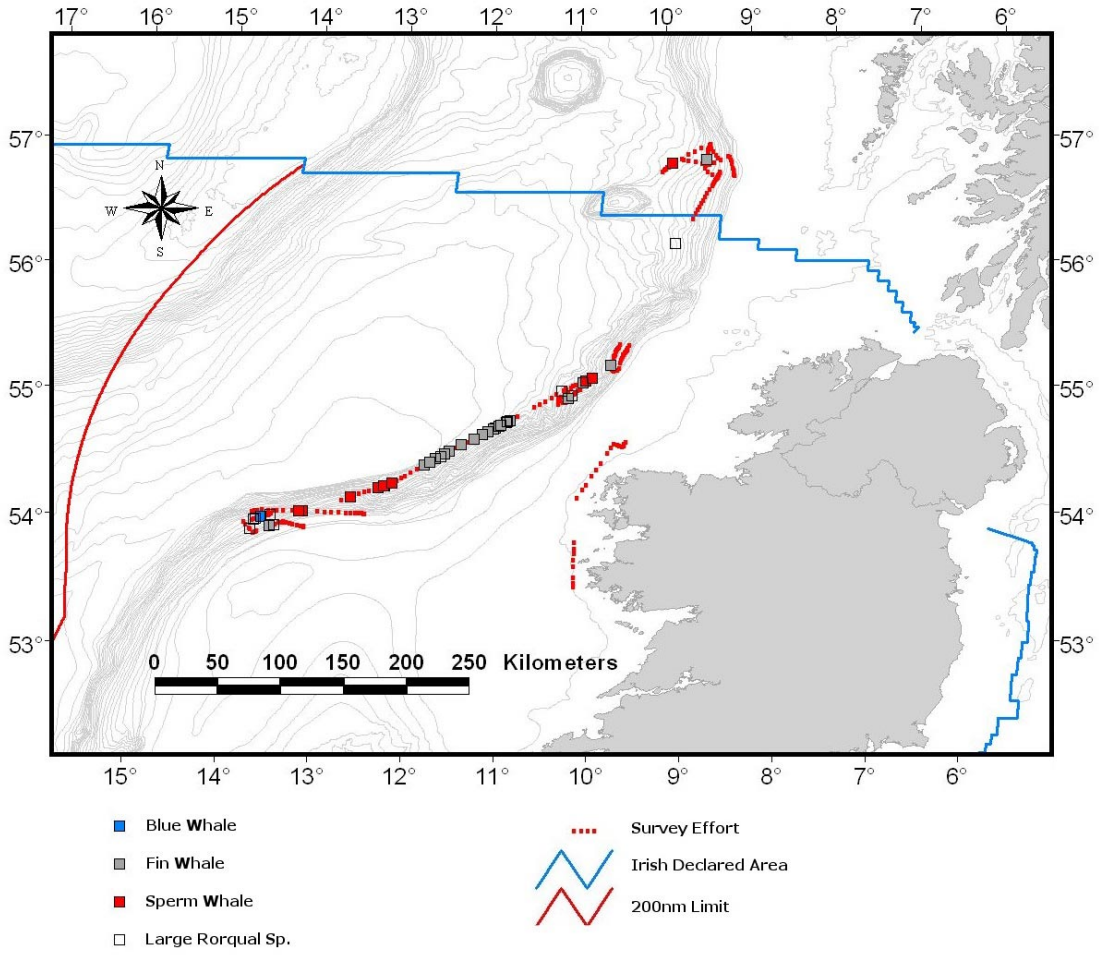


**Fig. 4** Distribution of sightings of whale species recorded during the current survey

Identified whale species were blue whale (*Balaenoptera musculus*), sperm whale (*Physeter macrocephalus*) and fin whale (*Balaenoptera physalus*).

The sighting of a blue whale on the northern slopes of the Porcupine Bank is significant as it is only the third sighting of this species in Irish waters and only the second blue whale to be photographed in Irish waters. Around the same time that this sighting occurred a second sighting was recorded off the Co. Kerry coast. Also of significance is the sighting of 45 fin whales and 18 other rorquals (thought to be either fin whales or blue whales). All animals were assumed to be feeding on krill, which was reported to be present in the water column by a BIM survey being conducted at the same time off the Co. Kerry coast. Dense marks were noted on the depth sounder in areas where the whales occurred. The depths of the marks varied from 500m on the lower shelf slopes of the continental shelf to 50-120m on the north slopes of the Porcupine Bank.

Most fin whales were noted in areas where depth marks were at 500m and dive times for those whales were in the region of 20-30 minutes. The blue whale was sighted in an area where marks were at 50-120m and the whale exhibited dive times averaging 10 minutes and blew 5-6 times (at intervals of 10-20sec) between dives.

A number of things indicate that the blue whale sighting over the north slopes of the Porcupine Bank and that off west Kerry are of different animals. The first is the distance involved (207km), The second is that the Porcupine Bank animal was seen to fluke on three separate occasions, whilst fluking was not reported in the Kerry animal at all. Evidence from elsewhere in the world is that only about 20-30% of animals fluke and that most animals which fluke tend to do so on a regular basis (Fred Wenzel pers. comm.). Finally the likelihood of re-sighting a single blue whale from among, perhaps, hundreds of large rorquals off the west coast of Ireland at the time of the sighting must be small indeed. The evidence would suggest that there was more than one blue whale present off the Irish coast during the period of this survey.

Common dolphin (© Dave Wall)

Pilot Whales (© Dave Wall)

Fin whales were the most commonly encountered species recorded during the survey whereas common dolphins were the most abundant (table 1).

Sperm whales were encountered on no less than 10 occasions during the survey. The majority of these sightings occurred over the shelf slopes in water depths less than 2000m. A number of sperm whale sightings occurred in waters over or adjacent to deep-water canyons which occur along the northern slopes of the Porcupine Bank and this area may represent an important habitat for this species.

Table 1: Sightings, counts and group size ranges for cetaceans sighted during current survey.

| Species | No. Sightings | No. Individuals | Range of Group Size |
|---|---|---|---|
| Bottlenose dolphin | 1 | 6 | |
| *Common dolphin* | 17 | 519 | 3-200 |
| *Striped Dolphin* | 1 | 8 | |
| *Pilot whale* | 5 | 39 | 1-12 |
| ***Sperm whale*** | 10 | 13 | 1-3 |
| *Blue whale* | 1 | 1 | |
| *Fin whale* | 22 | 45 | 1-5 |
| *Large rorqual* | 14 | 18 | 1-3 |
| **Unidentified beaked whale** | 2 | 3 | 1-2 |
| *Unidentified dolphin* | 4 | 105 | 5-50 |

## Bird Activity

Daily species lists were made of all seabird species seen around the survey vessel. 10 seabird species were recorded during the survey (table 2): Great skua (*Stercorarius skua*), parasitic skua (*Stercorarius parasiticus*), gannet (*Morus bassanus*), great black-backed gull (*Larus marinus*), lesser black backed gull (*Larus fuscus*), kittiwake (*Rissa tridactyla*), Manx shearwater (*Puffinus puffinus*), sooty shearwater (*Puffinus griseus*), fulmar (*Fulmarus glacialis*), and storm petrel (*Hydrobates pelagicus*). A number of waders were also noted on or around the vessel during the survey.

**Table 2:** Daily seabird species lists recorded during current survey.

| | September | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 19 | 22 |
| **Auk Species (all)** | x | | | | | | | | | |
| **Gannet** | x | x | x | x | x | x | x | x | x | x |
| **Fulmar** | x | x | x | x | x | x | x | x | x | x |
| **Manx Shearwater** | x | | | | | | | | | x |
| **Sooty Shearwater** | x | x | x | x | x | x | x | x | x | x |
| **Kittiwake** | | x | x | | x | x | x | x | x | x |
| **Lesser Black-backed Gull** | | x | x | x | x | x | x | x | | x |
| **Great Black-backed Gull** | | | | | | | | | | x |
| **Great Skua** | | x | x | x | x | x | x | x | x | x |
| **Parasitic Skua** | | | x | | x | x | x | | | |
| **Storm-petrel** | x | x | x | x | x | x | x | x | x | x |
| | *West Coast Inshore* | *Shelf Slopes W. of Hebrides* | | | | | *N. Slopes Porcupine Bank* | | | *Porcupine Bank* |

Parasitic Skua (© Dave Wall)

Sooty Shearwater (© Dave Wall)

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**Appendix II: List of cetacean species recorded within the Irish EEZ and adjacent waters.**

| | |
|---|---|
| Atlantic White-Sided Dolphin | *Lagenorhynchus actus* |
| Beluga | *Delphinapterus leucas*† |
| Blue Whale | *Balaenoptera musculus* |
| Bottlenose Dolphin | *Tursiops truncatus* |
| Common Dolphin | *Delphis delphis* |
| Cuvier's Beaked Whale | *Ziphius cavirostris* |
| False Killer Whale | *Pseudorca crassidens* |
| Fin Whale | *Balaenoptera physalus* |
| Gervais' Beaked Whale | Mesplodon europaeus* |
| Harbour Porpoise | *Phocoena phocoena* |
| Humpback Whale | *Megaptera novaeangliae* |
| Killer Whale | *Orcinus orca* |
| Minke Whale | *Balaenoptera acutorostrata* |
| Northern Bottlenose Whale | *Hyperoodon ampullatus* |
| Northern Right Whale | *Eubalaena glacialis* |
| Pilot Whale (long-finned) | *Globicephala melas* |
| Pygmy Sperm Whale | *Kogia breviceps* |
| Risso's Dolphin | *Grampus griseus* |
| Sei Whale | *Balaenoptera borealis* |
| Sowerby's Beaked Whale | *Mesplodon bidens* |
| Sperm Whale | *Physeter macrocephalus* |
| Striped Dolphin | *Stenella coeruleoalba* |
| True's Beaked Whale | *Mesplodon mirus* |
| White-Beaked Dolphin | *Lagenorhynchus albirostris* |

† *Vagrant* * *Recorded only from Stranding*

# Appendix 3

**Preliminary cruise report (CE0811 – Deepwater survey 2008)**

**Hydrographic and phytoplankton sampling**

A total of 44 CTD stations were sampled during the cruise using the onboard Seabird CTD System (SBE 911plus). The system was equipped with sensors for pressure, temperature, conductivity, oxygen and transmissivity. No water samples were taken. At all stations up- and downcast profiles were taken at five transects along the Irish and Scottish continental margins over the whole water column down to 10-30 m above the seafloor (depending on the observed bottom roughness and slope angle). This cruise provided the opportunity to repeat three of the five transects within 24 hours to study the effect of high frequency variability on water mass properties along the shelf edge. A list of station locations and times is provided in Table 1 together with a location map (Figure 1). The raw CTD data were post-processed on board following the Seabird standard procedure for its 911plus system. The processing steps included:

- Conversion from raw binary data to engineering units
- Separation of each sampling profile into up-cast and down-cast profile
- Identifying and labelling large data errors (outliers to be excluded from further processing) in the downcast profile
- Low pass filtering of the pressure and conductivity channel to reduce high-frequency noise
- Correction for pressure inversions caused by ship motion
- Averaging all data of the downcast profile into 1 m depth intervals
- Final scan of the data for density inversions (‘unstable’ depth layers)

In addition to the in-situ station sampling, a ship-mounted ADCP system was operated during the cruise to measure the three-dimensional flow field and to monitor the deep scattering layer for daily vertical zooplankton migration patterns. The primary instrument was the Celtic Explorer’s RDI 75 kHz Ocean Surveyor system. The data acquisition was configured for 8 m bins (400 m maximum range) in shallow water (less than 200 m) and 16 m bins (maximum range 800 m) in waters deeper than 200 m respectively. Bottom tracking was activated during the whole cruise. Data processing will be finalized after the cruise using the CODAS3 (Common Oceanographic Database Access System, University of Hawaii) shipboard ADCP processing suite.

Phytoplankton sampling at 20 selected stations (see Table 1) was carried out using a 20 μm mesh net, 1 m long with an opening of 15 cm diameter and a collector volume of 200 ml. The net was hauled vertically from the surface down to 100 m depth and back at a speed of 0.5 m/s. The collected material was preserved in neutralized formalin (final concentration 0.6%)

**Table 1:** List of CTD stations, locations and times. Highlighted stations included phytoplankton sampling.

| Number | CTD station | Latitude | Longitude | Depth | Start time |
|---|---|---|---|---|---|
| 1 | **A2_750** | 56.6653 | -9.1010 | 740 | 11/09/2008,21:58 |
| 2 | **A2_1000** | 56.6500 | -9.2252 | 1037 | 11/09/2008,23:27 |
| 3 | **A2_1250** | 56.6712 | -9.3480 | 1252 | 12/09/2008,01:03 |
| 4 | **A2_1500** | 56.6943 | -9.5332 | 1507 | 12/09/2008,03:15 |
| 5 | **A2_200R** | 56.6547 | -8.9833 | 215 | 12/09/2008,20:55 |
| 6 | **A2_450R** | 56.6590 | -9.0217 | 458 | 12/09/2008,21:37 |
| 7 | A2_750R | 56.6653 | -9.1010 | 740 | 12/09/2008,22:42 |
| 8 | A2_1000R | 56.6500 | -9.2252 | 1035 | 12/09/2008,23:57 |
| 9 | A2_1250R | 56.6712 | -9.3480 | 1255 | 13/09/2008,01:25 |
| 10 | A2_1500R | 56.6943 | -9.5332 | 1504 | 13/09/2008,03:13 |
| 11 | A4_2000 | 55.3228 | -10.3663 | 2160 | 14/09/2008,23:14 |
| 12 | A4_1500 | 55.2893 | -10.2593 | 1530 | 15/09/2008,01:15 |
| 13 | A4_1000 | 55.2502 | -10.1363 | 1005 | 15/09/2008,02:55 |
| 14 | A4_750 | 55.2340 | -10.0887 | 746 | 15/09/2008,04:00 |
| 15 | A4_450 | 55.2210 | -10.0395 | 430 | 15/09/2008,04:50 |
| 16 | A4_200R | 55.1983 | -9.9525 | 205 | 15/09/2008,19:33 |
| 17 | A4_450R | 55.2210 | -10.0395 | 433 | 15/09/2008,20:28 |
| 18 | A4_750R | 55.2340 | -10.0887 | 760 | 15/09/2008,21:10 |
| 19 | A4_1000R | 55.2502 | -10.1363 | 1005 | 15/09/2008,22:05 |
| 20 | A4_1500R | 55.2893 | -10.2593 | 1550 | 15/09/2008,23:40 |
| 21 | A4_2000R | 55.3228 | -10.3663 | 2050 | 16/09/2008,01:32 |
| 22 | A5C_2000 | 54.1230 | -13.2427 | 2090 | 16/09/2008,22:05 |
| 23 | A5C_1750 | 54.1035 | -13.2423 | 1715 | 16/09/2008,23:37 |
| 24 | A5C_1500 | 54.0852 | -13.2400 | 1489 | 17/09/2008,00:48 |
| 25 | A5C_1250 | 54.0488 | -13.2373 | 1253 | 17/09/2008,02:00 |
| 26 | A5C_1000 | 54.0072 | -13.2308 | 1014 | 17/09/2008,02:58 |
| 27 | A5C_750 | 53.9730 | -13.2252 | 737 | 17/09/2008,04:12 |
| 28 | A5C_500 | 53.9312 | -13.2177 | 486 | 17/09/2008,05:05 |
| 29 | A5E_500 | 53.9503 | -12.8502 | 488 | 17/09/2008,23:17 |
| 30 | A5E_750 | 53.9898 | -12.8155 | 773 | 18/09/2008,00:29 |
| 31 | A5E_1000 | 54.0327 | -12.7794 | 1090 | 18/09/2008,01:35 |
| 32 | A5E_1250 | 54.0752 | -12.7472 | 1250 | 18/09/2008,02:55 |
| 33 | A5E_1500 | 54.1322 | -12.7057 | 1502 | 18/09/2008,04:22 |
| 34 | A5W_1250 | 53.8865 | -13.9682 | 1247 | 18/09/2008,23:05 |
| 35 | A5W_1000 | 53.8448 | -13.9063 | 1003 | 19/09/2008,00:29 |
| 36 | A5W_750 | 53.8048 | -13.8338 | 762 | 19/09/2008,01:40 |
| 37 | A5W_500 | 53.7895 | -13.7437 | 500 | 19/09/2008,02:43 |
| 38 | A5W_350 | 53.7585 | -13.6207 | 337 | 19/09/2008,03:45 |
| 39 | A5W_350R | 53.7585 | -13.6207 | 340 | 19/09/2008,21:10 |
| 40 | A5W_500R | 53.7895 | -13.7437 | 490 | 19/09/2008,22:59 |
| 41 | A5W_750R | 53.8048 | -13.8338 | 750 | 20/09/2008,00:10 |
| 42 | A5W_1000R | 53.8448 | -13.9063 | 1000 | 20/09/2008,01:25 |
| 43 | A5W_1250R | 53.8865 | -13.9682 | 1280 | 20/09/2008,02:55 |
| 44 | A5W_1500R | 53.9278 | -14.0248 | 1509 | 20/09/2008,04:17 |

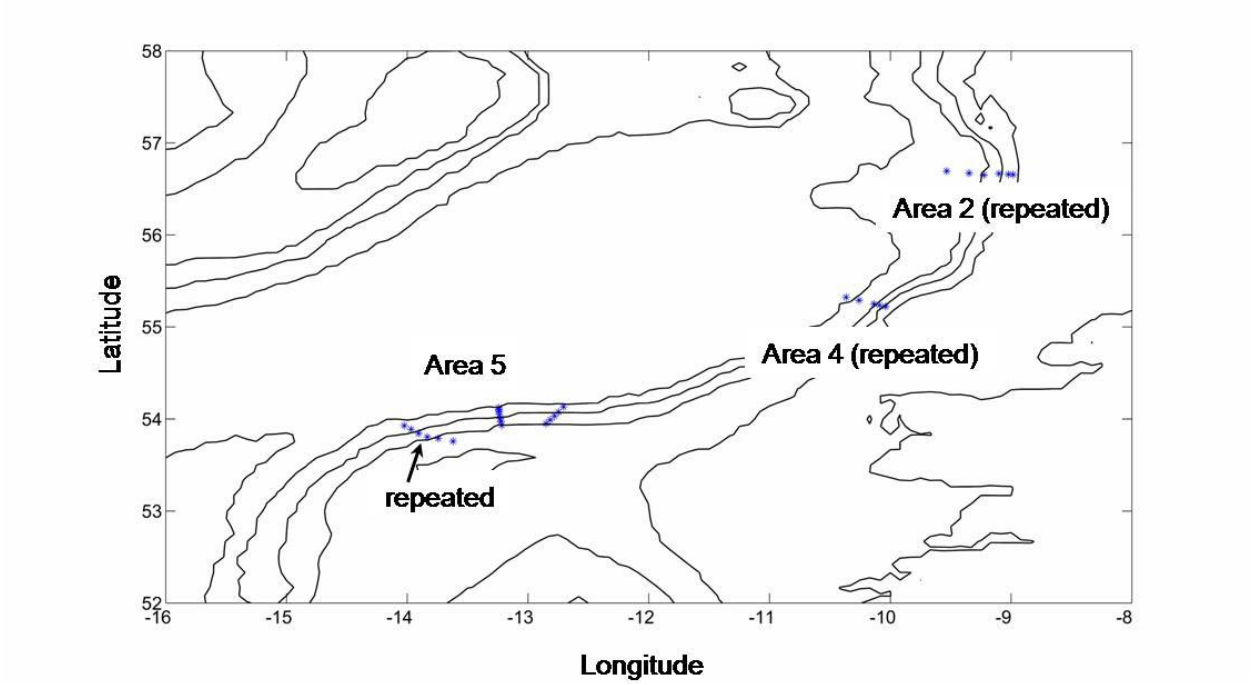


**Figure 1:** CTD station location map

## Preliminary results

One focus of the hydrographic programme of the cruise was to carry out repeated surveys at 3 transects within 24 hours to assess and study the possible impact of high frequency variations (tides, internal waves) and how they are manifested in the main water mass properties. As an example, Figures 2 and 3 show the potential temperature and salinity properties along transect A2 northeast of Hebrides Terrace at the northernmost sampling area. Significant variations in both variables, temperature and salinity, were found to dominate at greater depths. The strongest differences appear in the depth range 500 to 1000 m. The most prominent signal was a dipole-like pattern in the temperature and salinity fields. Difference plots shown in Figures 2 (c) and 3 (c) indicate a cross-shelf oscillating pattern with the strongest response at the shelf break below 500 m water depth. Temperature and salinity differences were up to 0.5 °C and 0.03 respectively translating into vertical excursions of individual isolines of up to 100 m over the course of one day. Further analysis will emphasize on aspects of tide-topography interaction at all repeated transects by analyzing the complementary ADCP data and extracting the dominant barotropic tidal characteristics at the sampling locations and times from available sources such as the OSU (Oregon State University) inverse tidal model.

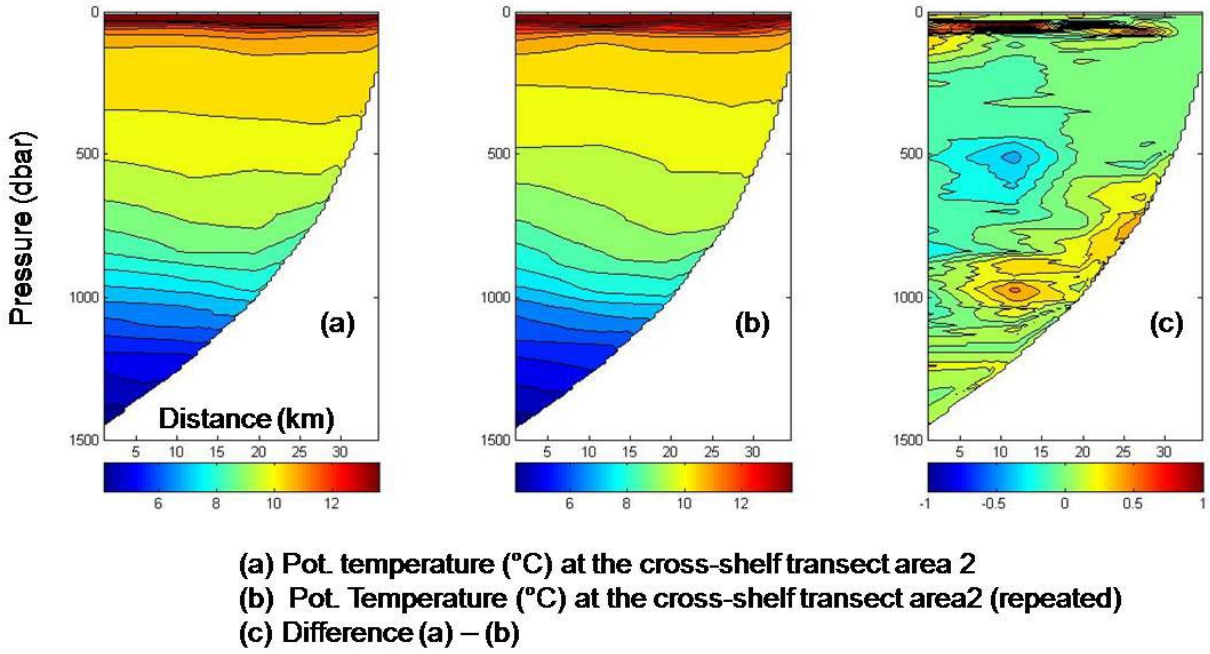


**Figure 2:** Potential temperature at the area 2 sampling locations

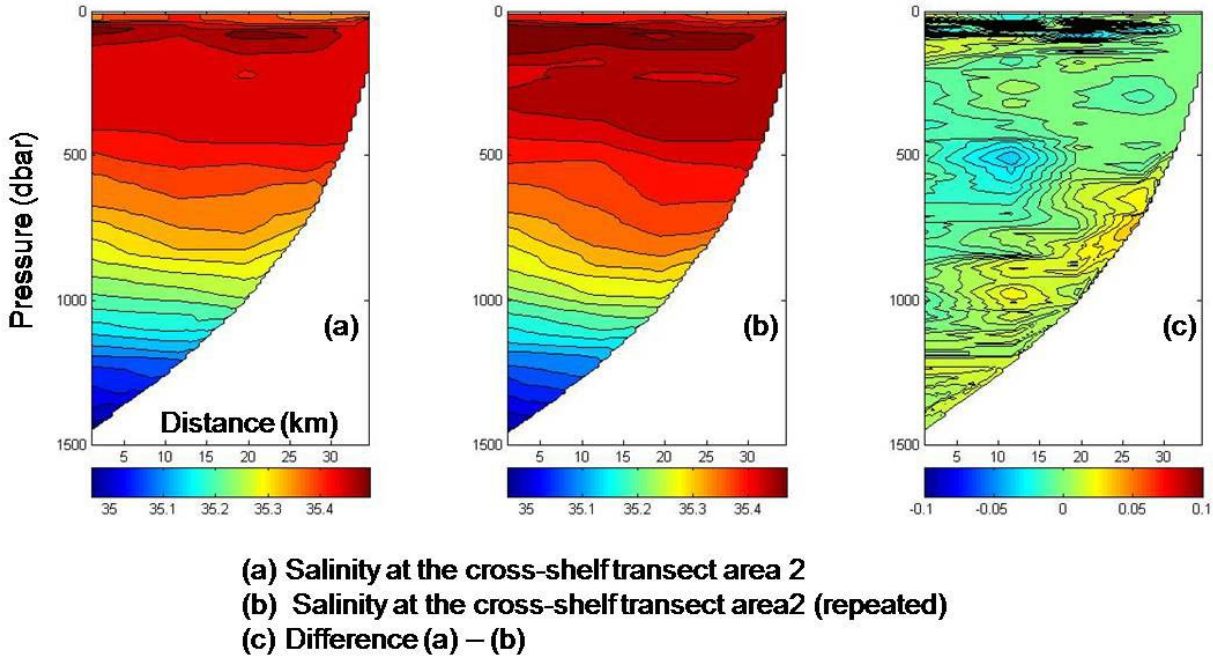


**Figure 3:** Salinity at the area 2 sampling locations